2020 Local Update of Census Addresses (LUCA) Operational Assessment Report

A New Design for the 21st Century

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Executive Summary

The Census Bureau relies on a complete and accurate address list to reach every living quarter and associated population for inclusion in the decennial census. The 2020 Local Update of Census Addresses (LUCA) operation allowed tribal, state, and local entities the opportunity to review and update the Census Bureau's residential address list for their jurisdiction.

The 2020 LUCA operation included the following steps:

a. The Census Bureau provided registered entities the specific address list and maps for their jurisdiction.

b. Entities added, deleted, or changed addresses, changed address locations, and added or changed features.

c. The Census Bureau validated the updates via automated processes and In-Office Address Canvassing (IOAC).

d. The Census Bureau processed and incorporated accepted updates to the Master Address File/Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) System.

e. The Census Bureau provided feedback to the participating entities.

f. Entities appealed addresses based on LUCA feedback codes and the Census Bureau validated appealed records based on enumeration.

After LUCA received Office of Management and Budget (OMB) approval in December 2016, the operation sent out advance notices to eligible tribal, state, county, and local entities in January 2017. Invitation and registration occurred from July 2017 to August 2018 where 39,327 entities were invited and 11,549 registered for LUCA. Participants reviewed the Census Bureau's address list and sent their updates back from March through November 2018. The Census Bureau received 8,628 submissions and of those, about 17.5 percent were received late without an extension. Of 17.5 percent received late without an extension, the Census Bureau processed 76 percent because the remainder arrived too late to be included in the April 2019 update process.

From the submissions that were received in time to process, LUCA received 22,670,000 address updates and processed 97.7 percent of the address updates. The Census Bureau processed LUCA addresses, conducted LUCA Address Validation, and updated the Master Address File (MAF) from March 2018 to April 2019. About 81 percent of the more than 22 million addresses sent to matching matched to the MAF. While adds that do not match to the MAF are often new addresses, they sometimes can be duplicate addresses that were formatted differently than the MAF address. Of the adds that did not match to the MAF, 37.6 percent were enumerated or found vacant, meaning they were most likely a valid address, and 62.4 percent were not enumerated, meaning most likely they were not a valid address at the time of the 2020 Census. In total, about 5.3 percent of all address updates received in LUCA were adds that did not match the MAF and were enumerated in the 2020 Census.

Feedback materials were sent to eligible participants from July to September 2019. OMB processed LUCA appeals from September 2019 to February 2020. Of the 6,955 entities eligible for appeals, 19.2 percent submitted an appeal to their LUCA feedback. Of the approximately 127,000 appealed addresses, the OMB appeals office accepted 58.8 percent of the addresses. The Census Bureau enumerated 47.0 percent of the accepted appealed records in the supplemental enumeration universe. During LUCA, the Geographic Partnership Support Desk (GPSD) received 15,128 calls. The actual cost of LUCA was $23,770,478, which was under budget.

Successes

2020 LUCA successes included the following:

- Recommendations from 2010 LUCA were successfully applied to 2020 LUCA. Some examples include:
    - Eliminating the option for LUCA participants to submit their full address list without comparing it to the Census Bureau's address list and identifying the differences.
    - Providing participants in areas with non-city-style addresses with updated address lists and maps during the feedback phase rather than having them challenge counts by block.
- The GPSD used a centralized staff to answer initial questions about LUCA, which took pressure off the regional census centers (RCCs), provided additional customer support, and included a useful dashboard and reports.
- Promotional workshops for LUCA participants successfully helped the 2020 LUCA operation conduct outreach. These included hundreds of promotional workshops that the RCCs and Field Division conducted as well as LUCA workshops at Office of Congressional and Intergovernmental Affairs (OCIA) events which reached a wide audience.
- LUCA activities at the National Processing Center (NPC) had many successes. For example, staff learned from each mailing and successfully applied improvements to the next mailing, and Geography Division (GEO) floor support was helpful for troubleshooting issues.
- Partners liked the D-2209 FB Address Count List and used the counts to decide whether they were going to file an appeal.

Challenges

2020 LUCA experienced some challenges including the following:

- The framework of the 2020 LUCA needed early decade decisions, funding, and stakeholder agreement to minimize changes needing additional time and resources. For

example, the large set of LUCA materials required numerous revisions because of changes to LUCA and this took additional time and resources. Changes to LUCA rippled out and affected many materials, systems, and processes because some program details were undecided or lacked agreement.

- Some Census Bureau LUCA stakeholders and staff had different goals and expectations for 2020 LUCA, which sometimes created issues in priorities. For example, in previous decades, a key metric for LUCA was the number of registered participants. Some internal stakeholders used this as the key metric for 2020 LUCA while others expected the quality of the addresses submitted to be the key metric.
- From the perspective of participants, LUCA terms and processes were sometimes unclear or cumbersome. While the 2020 LUCA operation did try to simplify the materials and options for partners, partners still found many parts of 2020 LUCA unclear, which caused additional logistical work as well as submissions that did not meet the Census Bureau's standards and took more time to process.
- 2020 LUCA experienced challenges in submissions from both participant expectations that were not aligned with the operation and 2020 LUCA materials sometimes being unclear, which resulted in both the participants and the Census Bureau spending additional time on 2020 LUCA but often without positively affecting the quality of the MAF.
- The Census Bureau experienced challenges with creating the mailing extracts, particularly for the Advance Notice Mailing, because of insufficient resources and the challenging nature of overlapping or complex relationships that some entities or their contacts have, which resulted in some contacts receiving duplicate mailings and others not being contacted in Advance Notice.
- Some of the aspects of coordinating registration, mailing, and processing for 2020 LUCA were not ideal and caused additional work. For example, there were no simulated files for testing LUCA processes or a soft start where there was a scheduled time to work out any issues. Without test data or a soft start, processes experienced a backlog initially while staff quickly worked to resolve the issues.
- The Census Bureau encountered issues with processing coordinates from 2020 LUCA because some participants misunderstood the guidelines and provided mismatched latitude and longitude or the coordinates of a geographic boundary centroid rather than the housing unit.
- Additional time and resources were needed to process and match addresses when the Zone Improvement Plan (ZIP) Codes were not provided as part of the submission.

Recommendations

The following are recommendations for 2030 LUCA:

- **Create a LUCA Steering Committee that can create a common vision for the operation, a unified image to LUCA participants, and reduce the need for rework by having a**

central voice. The LUCA Steering Committee should involve key internal stakeholders in decisions, form a consensus, define roles and responsibilities within the Census Bureau, establish measures of success for the operation, and create universal policies for the operation.

- **Define LUCA expectations for participants that include clear policies in plain language, define what the Census Bureau can and cannot do and why, and how LUCA ties into the decennial census for their jurisdiction.** Work with the Communications Directorate to craft expectations that are clear in detail and positive in tone.
- **Make LUCA materials clearer for participants by applying plain language, streamlining materials, involving address subject matter experts, and outlining the entire LUCA process.** These strategies for clear communication should aim to reduce the number of issues in registration and submissions as well as create a better partnership with participants.
- **Develop interactive computer-based training for LUCA participants and a decision tree.** The training and decision tree will give participants the tools to make good choices about address updates based on Census Bureau needs to reduce issues in submissions and increase the amount of quality addresses that will benefit the 2030 address frame.
- **Begin LUCA earlier in the decade to allow for testing, a soft start, and more processing time.**
- **Research restricting LUCA actions to only adds and deletes and test this method with a variety of LUCA partners prior to 2030 LUCA.**
- **Conduct testing for 2030 LUCA and use a soft start to reduce challenges similar to those experienced in 2020 LUCA.** Also, test operational efficiencies recommended for 2030 LUCA ahead of the operation. Research what timing will best fit the needs of LUCA and allow time for any needed changes to be applied. Testing should include a variety of partners, all portions of the LUCA process including feedback, and include the quality control (QC) plans developed by the Decennial Statistical Studies Division (DSSD).
- **Conduct research on how to collect ZIP Codes and coordinates in 2030 LUCA and what guidelines need to be provided to participants about these topics.**
- **Conduct research on the best method to update group quarters (GQs) and transitory locations (TLs) in LUCA in conjunction with the Census Bureau GQ Working Group.**
- **The 2030 LUCA Steering Committee should define how the LUCA operation will measure quality by working with DSSD to develop statistically sound QC plans, implement them in future work, and meet periodically to assess if the work and staff are meeting quality standards and what those standards mean.** The following are areas that should be included:
    - Quality of the Design: the quality of both new and legacy elements of the operation and the effect they have on the operation.

  - Quality of the Addresses Received and the Effects on the Address Frame: the quality of data received from participants as well as both positive and negative effects the updates have on the 2030 address frame.
  - Quality of Processing: the quality of processing updates and the effect on the 2030 address frame.
  - Quality of Feedback: the usefulness of the feedback the Census Bureau provides to participants.

- **Provide tools and resources LUCA participants can use to prepare their own address list before LUCA.** These tools and resources may include:
  - Address count lists and associated interactive map viewers.
  - Geocoding tools.
  - Examples of acceptable and unacceptable address formats.
  - Guidelines for submitting addresses so that entities can identify addresses that they use, such as mile markers or fire hydrants, that the Census Bureau will not need.
  - Guidelines and examples of how to use these tools and resources to identify where entities have good coverage and where they may have coverage issues.
- **Research how best to prepare for 2030 LUCA invitations and outreach and ensure there are resources and funding for this method.**
- **Investigate a digital LUCA secure online system where LUCA participants could register, securely review the addresses for their jurisdiction, and submit their LUCA updates.**
- **Encourage LUCA participants to work with high-level governments and consolidate their submissions.**

1. Introduction

The Census Bureau relies on a complete and accurate address list to reach every living quarter and associated population for inclusion in the decennial census. The 2020 Local Update of Census Addresses (LUCA) operation allowed tribal, state, and local entities the opportunity to review and update the Census Bureau's residential address list for their jurisdiction.

This assessment documents the results of the 2020 LUCA operation. This document also includes lessons learned gathered from debriefings and observational input from headquarters, regional census centers (RCCs), and National Processing Center (NPC) staff. Finally, this assessment contains information to assist in implementing address update partnership programs in the future, as well as planning for the Geographic Support Program (GSP) and the 2030 Census.

1.1 LUCA Description

The Census Address List Improvement Act of 1994 (Public Law 103-430) authorized the Census Bureau to provide individual address information to officials of tribal, state, and local entities who agreed to conditions of confidentiality. The act strengthened the Census Bureau's partnership capabilities with participating entities by expanding the methods the Census Bureau could use to exchange address information. Since the Census Address List Improvement Act of 1994, there have been three LUCA operations in support of the 2000, 2010, and 2020 decennial censuses. Participation in LUCA is voluntary, but the Census Bureau strongly encouraged all entities to participate.

The 2020 LUCA operation included the following steps:

a. The Census Bureau provided registered entities the specific address list and maps for their jurisdiction based on the Census Bureau defined legal boundary as of the completion of the 2017 Boundary and Annexation Survey.
b. Entities added, deleted, or changed addresses, changed address locations, and added or changed features.
c. The Census Bureau validated the updates via automated processes and the Address Canvassing operation, specifically In-Office Address Canvassing (IOAC).
d. The Census Bureau processed and incorporated accepted updates to the Master Address File/Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) System.
e. The Census Bureau provided feedback to the participating entities.
f. Entities appealed addresses based on LUCA feedback codes, and the Census Bureau validated appealed records based on enumeration.

Table 1 shows a description of the entities that could participate in LUCA.

Table 1. 2020 LUCA Entity Table

Entity Type	Abbreviation	Description
American Indian Area	AIA	Areas that have been set aside by the United States for the use of tribes, the exterior boundaries of which are more particularly defined in the final tribal treaties, agreements, executive orders, federal statutes, secretarial orders, or judicial determinations. The Census Bureau recognizes federal reservations (and associated off-reservation trust lands) as territory over which American Indian tribes have primary governmental authority.
State	ST	The primary governmental divisions of the United States. In addition to the 50 states, the Census Bureau treats the District of Columbia, Puerto Rico, American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands as the statistical equivalents of states for the purpose of data presentation. The 50 states, the District of Columbia, and Puerto Rico were eligible for the 2020 LUCA operation.
County	CO	The primary legal divisions of states. County equivalents include parishes in Louisiana; municipios in Puerto Rico; the nonfunctioning counties in Massachusetts, Connecticut, and Rhode Island; the independent cities in Maryland, Missouri, Nevada, and Virginia; and the organized boroughs, city and boroughs, census areas, and municipalities in Alaska.
Minor Civil Division	MCD	The primary governmental or administrative divisions of a county in many states (parishes in Louisiana) and the county equivalents in Puerto Rico. MCDs in the United States, Puerto Rico, and the Island Areas represent many different kinds of legal entities with a wide variety of governmental and/or administrative functions.
Place	PL	Those reported to the Census Bureau as legally in existence as of January 1, 2017, as reported in the latest Boundary and Annexation Survey (BAS), under the laws of their respective states. A concentration of population either legally bound as an incorporated place or identified by the Census Bureau as a census designated place. An incorporated place is established to provide governmental functions for a concentration of people as opposed to a minor civil division, which generally is created to provide services or administer an area without regard, necessarily, to population. Census designated places are delineated to provide data for settled concentrations of population that are identifiable by name but are not legally incorporated under the laws of the state in which they are located. Places always are within a single state or equivalent entity but may extend across county and county subdivision boundaries.

Source: Geography Program Glossary (1).

1.2 Operational Changes Resulting from COVID-19

The COVID-19 pandemic did not affect the LUCA operation, unlike other 2020 Census operations, because the LUCA operation completed its work in early 2020.

1.3 Schedule

A subset of key activities/milestones for the LUCA operation from the final baselined version of 2020 Census Integrated Master Schedule (IMS) appears in Table 2.

Table 2. Key Activities/Milestones from the LUCA Operation

Activity or Milestone Name	Planned Start	Actual Start	Planned Finish	Actual Finish
Receive Office of Management & Budget Approval			12/16/2016	12/16/2016
Conduct LUCA Workshops	2/13/2017	2/13/2017	1/5/2018	1/5/2018
Conduct LUCA Trainings	10/6/2017	10/6/2017	9/28/2018	6/29/2018
Send Advance Notice Packages	1/20/2017	1/20/2017	1/30/2017	1/30/2017
Send Invitation Packages	6/14/2017	6/14/2017	8/1/2017	8/1/2017
Registration Period	7/26/2017	7/26/2017	8/14/2018	8/14/2018
Send Stateside Material Packages	2/15/2018	2/15/2018	4/13/2018	4/13/2018
Send Puerto Rico Material Packages	6/1/2018	5/29/2018	6/1/2018	5/31/2018
Receive Participant Return Materials	3/8/2018	3/8/2018	10/15/2018	11/28/2018
Process Participant Return Materials	3/8/2018	3/3/2018	11/30/2018	12/7/2018
Conduct LUCA Address Validation	4/26/2018	4/26/2018	3/29/2019	3/7/2019
Conduct MAF Update	4/1/2019	3/20/2019	4/3/2019	4/8/2019
Send LUCA Feedback Materials	7/18/2019	7/18/2019	8/30/2019	9/6/2019
Process LUCA Appeals	9/3/2019	9/3/2019	2/12/2020	2/3/2020

Source: U.S. Census Bureau, 2020 Census, Integrated Master Schedule.

After its planned finish of October 15, 2018, for participant submissions, the LUCA operation received and accepted LUCA submissions for an additional six weeks. This change meant that other scheduled items also completed after their planned finish dates, including the processing of LUCA returns and LUCA feedback.

2. Background

This section includes a description of the 2020 LUCA operation and related activities. Background includes information about previous LUCA activities, a brief discussion of previous research and operational tests, and an overview of the LUCA process for 2020.

Title 13, United States Code (U.S.C.), provides for the confidential treatment of address information and structure points showing the location of housing units or group quarters. Title 13 requires that all liaisons, reviewers, and anyone with access to Title 13 materials abide by the Confidentiality and Security Guidelines. Title 13 also requires that the Census Bureau maintain the confidentiality for all the address information that it collects.

2.1 2000 Census LUCA Operation

Census 2000 marked the first decennial census for which the Census Bureau could provide an address list to governments that signed the required confidentiality agreement. Addresses can include housing units (HUs) as well as other types of living quarters, such as group quarters (GQs) and transitory locations (TLs). The Census Bureau defines GQs as living quarters where people live, stay, or could live or stay in a group living arrangement managed or owned by an entity or organization that provides housing and/or services for residents. GQs include college residence halls, residential treatment centers, skilled nursing facilities, group homes,

correctional facilities, and workers' dormitories, among others. TLs are sites like motels, campgrounds, and RV parks, where people may be living or staying.

The Census 2000 LUCA operation (2000 LUCA) included two phases. The first phase, LUCA 98, included areas designated for mailout/mailback enumeration (Tomaszewski, 2007a; 2007b). These areas contained primarily city-style addresses, which the Census Bureau defines as those that have a house number and street name (e.g., 212 Elm Street or 137 Clark Ct., Apt. 316). These addresses were used for mailing or to provide location information for emergency services, such as police, fire, and rescue (E-911 addresses). LUCA 98 governments received the Census Bureau address list for review and updated the address list by adding new addresses not on the census address list, correcting addresses, deleting addresses, identifying nonresidential addresses, and identifying out of jurisdiction addresses.

The second phase, LUCA 99, included areas designated for Update/Enumerate or Update/Leave enumeration. These areas contain primarily non-city-style addresses, which the Census Bureau defines as those that do not contain a house number and/or a street name. Non-city-style mailing addresses include:

a. General delivery (General Delivery, Anytown, TX, 12345).
b. Rural route and box number (RR1 Box 234, Anytown TX, 12345).
c. Highway contract route and box number (HC 13, Box 345, Anytown, TX, 12345).
d. Post office box only delivery (PO Box 1234, Anytown TX, 12345).

Non-city-style addresses used by the Census Bureau also include location descriptions (e.g., BRICK HOUSE with ATTACHED GARAGE ON RIGHT) and a geographic reference such as a structure point (geographic coordinates) or census geographic codes including state code, county code, census tract number, and census block number. Since this style of address generally cannot be matched effectively to addresses in the Master Address File (MAF), LUCA 99 governments received address counts by block (block counts) of all living quarters addresses within their jurisdiction. These governments could review these counts and provide changes to the Census Bureau for census blocks where address count discrepancies existed rather than provide individual address updates.

The Census Bureau compared LUCA 98 submissions against the results of the Census 2000 Block Canvassing Operation, which occurred in early 1999. The Census Bureau compared LUCA 99 submissions against the results of the 2000 Address Listing Operation, which occurred in the latter half of 1998. Following this comparison process, both LUCA 98 and 99 governments received detailed feedback explaining discrepancies between their submissions and the results of Census Bureau fieldwork in Block Canvassing and Address Listing.

Entities in both operations had the option to appeal the results of the Census Bureau's address comparison process. Address appeals were submitted to the Census 2000 LUCA Appeals Office, an independent, temporary federal entity set up by the Office of Management and Budget (OMB) to administer the appeals process. The Census Address List Improvement Act of 1994

requires that the Administrator of OMB's Office of Information and Regulatory Affairs, acting through the Chief Statistician and in consultation with the Census Bureau, develop an appeals process to resolve any disagreements that may remain after participating governments receive the Census Bureau's LUCA feedback materials.

The Census Bureau reinstated addresses approved by the Appeals Office into the census process and sent them to the field for enumeration in the Coverage Improvement Follow-up (CIFU) operation.

2.2 2010 Census LUCA Operation

As a result of the LUCA State Survey and 2000 LUCA evaluations and participant surveys conducted by the National Academy of Sciences (NAS), the Department of Commerce Office of the Inspector General (OIG), the Office of Management and Budget (OMB), and the Census Bureau, a number of suggested improvements were made to LUCA (Pfeiffer and Franz, 2005) for the 2010 Census. Based on these results, the Census Bureau made the following changes to the 2010 Census LUCA operation (2010 LUCA):

a. Combined the two separate Census 2000 LUCA phases into one review cycle for all address types.

b. Expanded the review time for governments from 90 days to 120 days.

c. Provided more advance notice of the pending LUCA operation.

d. Initiated comprehensive communications with governments.

e. Provided governments the opportunity to use the Census Bureau supplied MAF/TIGER Partnership Software (MTPS) application.

f. Invited states to participate in LUCA.

g. Provided the choice of one of the following three participation options:

- Option 1 – Title 13 Full Address List Review.
- Option 2 – Title 13 Local Address List Submission.
- Option 3 – Non-Title 13 Local Address List Submission.

After signing that they agreed to the requirements for Title 13 confidentiality, Option 1 and Option 2 governments received the census address list for their jurisdiction. Option 1 governments could choose either a paper (6,000 addresses or fewer) or computer-readable address list and could update the address list by correcting addresses, changing the location of addresses, deleting addresses, identifying nonresidential addresses and out of jurisdiction addresses, and adding new addresses not on the census address list. In addition, they could challenge the number of addresses within a census block.

Option 2 governments could only receive the census address list in computer-readable format for reference purposes and were required to submit their local address file of city-style addresses in a format predefined by the Census Bureau.

Option 1 and Option 2 governments received detailed feedback of the results of the Address Canvassing operation, which updated the census address list and verified addresses submitted by LUCA governments. Governments were eligible to file address appeals with the 2010 LUCA OMB Appeals Staff.

Option 3 governments chose not to receive the census address list and therefore were not required to sign the Confidentiality Agreement Form. They received the 2010 Census LUCA Address Count List for reference only and were required to submit their local address file of city-style addresses in a predefined format. Option 3 governments received a Feedback Address Update Summary Report of the total address tallies for their jurisdiction. However, since they did not receive the census address list or detailed feedback, they could not appeal addresses.

All governments received the 2010 Census LUCA Address Count List that contained the total number of HU and GQ addresses on the census address list for each census block within their jurisdiction (U.S. Census Bureau, User Guide, August 2007). Governments could provide map feature and legal boundary updates regardless of the option they selected.

2.3 Research for the 2020 Census LUCA Operation

To meet the objectives of increasing participation and coverage while reducing costs, and identifying ways to improve the quality of updates, the *Local Update of Census Addresses 2020 Program Improvement Team* identified four research activities:

a. *The 2010 Local Update of Census Addresses Looking Back Subteam* explored assessments and related documents associated with the 2010 Census LUCA and 2010 New Construction program.

b. *The Geographic Support System (GSS) Initiative*[1] *and Local Update of Census Addresses Partnership Subteam* researched the impact of the Geographic Support System on the 2020 Census LUCA operation.

c. *The Local Update of Census Addresses and the Targeting Environment Subteam* researched the impact of Reengineering Address Canvassing on the 2020 LUCA operation.

d. *The Focus Group Implementation Subteam* conducted focus groups to obtain feedback from partners on potential 2020 LUCA operation models.

[1] The Geographic Support System (GSS) Initiative offered a continuous plan to provide the most current, accurate, and complete address, feature, and boundary data to the Census Bureau's customers and data users. The GSS purpose was to maintain the Census Bureau's geographic framework for data collection, tabulation, and dissemination annually between decennial censuses to support ongoing programs such as the American Community Survey, other current surveys, and population estimates programs.

2.3.1 LUCA Recommendations

The subteams' research resulted in the following recommendations for the 2020 LUCA operation:

- Eliminate the Option 2 and Option 3 full address list submission.[2]
- Reduce the complexity of the 2020 LUCA operation.
- Include census structure coordinates in the census address list and allow partners to return their structure coordinates as part of their submission.
- Provide ungeocoded United States Postal Service (USPS) Delivery Sequence File (DSF) addresses to state and county partners.
- Provide the address list in more standard formats.
- Include an in-office verification of LUCA submitted addresses.
- Utilize Geographic Support System tools and data to validate LUCA submissions.
- Encourage entities at the lowest level to work with larger entities to consolidate their submissions.
- Eliminate the Block Count Challenge.[3]
- Require unit designators for multiunit structures.
- Encourage LUCA entities to identify E-911 addresses used for mailing, location, or both.
- Continue the successful 2010 Census LUCA improvements.

2.4 2020 Census LUCA Operation

The Census Bureau used the recommendations from the LUCA 2020 Program Improvement Team to design and implement the 2020 LUCA operation and began the process to acquire OMB approval in late 2015. The operation included three major areas: LUCA Mailings, LUCA Materials Processing, and LUCA Feedback and Appeals. Each area and the enumeration of LUCA records are explained in more detail below.

2.4.1 2020 LUCA Mailings

This section describes how the LUCA operation contacted potential LUCA participants.

2.4.1.1 Advance Notice

[2] Option 2 and Option 3 allowed governments to submit their address list to the Census Bureau, but not comment on the Census Bureau address list or challenge block address counts. Governments that selected Option 2 received a Title 13 copy of the Census Bureau address list for their jurisdiction and governments that selected Option 3 did not.

[3] In areas with non-city-style addresses, (e.g., rural route and box number or post office box numbers), the LUCA liaisons could challenge the count of housing unit and group quarter addresses. After the 2010 Census Address Canvassing Operation, the Census Bureau provided LUCA participants with an updated address list and maps during the feedback phase.

2020 LUCA Advance Notice packages were mailed to eligible entities. Advance Notice packages were also mailed to planning agencies and organizations to assist with outreach, although they were not eligible to participate. The Census Bureau used the Geographic Program Participant System (GPP) to generate contact information and mailing addresses to mail packages to entities and organizations.

In January 2017, the Census Bureau sent an Advance Notice package to 39,246 tribal, state, and local entities within the 50 states, the District of Columbia, and Puerto Rico that were eligible for 2020 LUCA. This package informed the highest elected official (HEO) and selected entity officials of the upcoming LUCA operation. The Advance Notice package explained the LUCA operation to those officials and provided them an opportunity to inform the Census Bureau of HEO changes and other contact information updates. The 2020 LUCA Advance Notice packages contained:

- One of the following letters announcing the 2020 LUCA operation:
    - Letter to state HEOs.
    - Letter to tribal and local HEOs and courtesy copies (CCs).
    - Letter to regional planning agencies, Councils of Governments, and similar interested parties.
- An HEO Information Update Form, which allowed the entities to provide contact information updates to the Census Bureau.
- A Contact Information Update Form, which allowed the entities to provide contact information updates to the Census Bureau.
- 2020 Census Local Update of Census Addresses Operation (LUCA) Information Guide.
- Access to an Address Count List showing the number of HUs, GQs and TLs in every census block in the entity.
- A postage-paid return envelope.

In addition to the Advance Notice packages, the Census Bureau provided tools to the potential LUCA partners. These tools included an Address Count List for each entity, as well as a public geocoding tool. Potential LUCA partners were able to load their own residential address list into the Census Bureau's geocoding tool to generate a count of residential addresses by block and compare it to the Census Bureau's count of residential addresses by block. This allowed potential LUCA partners to see where the Census Bureau's residential address count differed from their own and to assess their need to participate in the LUCA operation.

After mailing the 2020 LUCA Advance Notice packages, the Census Bureau offered promotional workshop sessions to entities interested in participating in the LUCA operation. The Census Bureau conducted 690 2020 LUCA promotional workshops from February 13, 2017, through January 15, 2018. The Census Bureau hosted the promotional workshops at a meeting site convenient for the eligible participants, by videoconferencing, or by webinar. These workshops emphasized the purpose and importance of the LUCA operation, and described the operation

schedule, material choice options, confidentiality requirements, participant responsibilities, and the planned LUCA materials supplied by the Census Bureau.

2.4.1.2 Invitation & Registration

In July 2017, the Census Bureau began mailing the Invitation and Registration packages to 39,327 eligible entities formally inviting them to participate in the 2020 Census LUCA operation. The universe for the advance notice mailing was 39,246. After this universe was created, it was discovered that 81 entities were missing from the universe because of an error with the initial criteria used to define the list of eligible governments. The 81 entities were included in the invitation mailing, therefore increasing the invitation mailing universe to 39,327. This package explained the operation to the entities and included an introduction of the Geographic Update Partnership Software (GUPS) that could be used for LUCA. It also provided information about the registration period from July 2017 to December 2017, along with the registration forms for the HEOs to fill out and return to the Census Bureau indicating whether they were participating. The 2020 LUCA Invitation and Registration packages contained:

- One of these letters inviting entities to participate in 2020 LUCA:
    - Invitation letter to local and tribal HEOs and CCs.
    - Invitation letter to state governors and CCs.
    - Invitation announcement to planning agencies, Council of Governments, State Data Centers (SDC), Federal-State Cooperative Program for Population Estimates (FSCPE), etc., that their member entities were invited to participate in the LUCA operation.
- Registration form for HEOs only, including a “Reason Why Not Participating” checklist.
- Material Choice Form for local and tribal HEOs.
- GIS Preference/County Selection Form to state HEOs only, allowing them to select either GUPS or digital address lists.
- Confidentiality and Security Guidelines to HEOs only.
- Confidentiality Agreement Form to HEOs only.
- Self-Assessment Security Checklist to HEOs only.
- 2020 Census Local Update of Census Addresses (LUCA) Operation Information Guide.
- Prepaid Return Shipping envelope.

In addition to the invitation materials, the Census Bureau published a Registration Map Viewer that showed all the entities that had registered to participate in LUCA within the map viewer. This supported the recommendation to encourage entities at the lowest level to work with larger entities to consolidate their submissions. It allowed for overlapping entities to coordinate their LUCA review. For example, a county was not providing updates for a city within their county that was also participating and providing updates.

Following the Census Bureau's receipt of the registration materials, the Census Bureau offered technical training workshops to entities interested in participating in the LUCA operation. Technical training workshops occurred at a meeting site convenient for the registered participants, by videoconferencing, or by a webinar on the internet. The training workshops provided the participants with detailed instructions and examples on how to review/update and return their LUCA submissions to the Census Bureau.

2.4.1.3 Puerto Rico

Because of the devastation of Hurricane Maria to the island of Puerto Rico in the fall of 2017, the Census Bureau extended the invitation and registration deadline until the end of January 2018. All participating entities from Puerto Rico registered as digital address participants. Because of the impacts of the hurricane, the material mailing was delayed until June 1, 2018, and entities had the full 120 days for their review.

2.4.1.4 LUCA Participant Review Materials

LUCA Participant Review Materials packages were shipped to the 11,549 tribal, state, and local entities that registered for 2020 LUCA from February 2018 through May 2018. This package included the address and mapping materials needed to complete entity review, the associated instructional materials, and in some cases, it included software the participant could use to conduct their LUCA review.

The complete initial package (in English except for Puerto Rico entities, which were in Spanish) consisted of the following materials:

- Inventory Checklist.
- Destruction or Return of Title 13 Materials Form.
- The 2020 Census LUCA Respondent Guide, Paper Address List Format.
- The 2020 Census LUCA Respondent Guide, Digital Address List Format.
- The 2020 Census LUCA Respondent Guide: Instructions for Using the Geographic Update Partnership Software (GUPS).
- Prepaid shipping envelope.
- Requested Material Choice Products.

The material choice selected by the participating entities determined the products the entities received to do their review. Table 3 describes the materials included in each material choice option, although all respondent guides were accessible on the LUCA website.

Table 3. 2020 LUCA Material Choice Products

Material Choice	Address Products	Map Products
Paper/Paper	Paper address products that include: D-2007 Census Address List D-2008 Address List Add Page D-2009 Address Count List 2020 Census LUCA Respondent Guide, Paper Address List Format	Large Format Paper Maps only Map Sheet Relationship List
Paper/Paper PDF	Paper address products that include: D-2007 Census Address List D-2008 Address List Add Page D-2009 Address Count List 2020 Census LUCA Respondent Guide, Paper Address List Format	Large Format Paper Maps PDF Small Format Maps
Paper/Digital	Paper address products that include: D-2007 Census Address List D-2008 Address List Add Page D-2009 Address Count List 2020 Census LUCA Respondent Guide, Paper Address List Format	Digital Maps are on one data disc and a separate disc contains the courtesy software installation for the GUPS 2020 Census LUCA Respondent Guide, Instructions for Using the Geographic Update Partnership Software (GUPS)
Digital/Paper	Digital Address List on one data disc 2020 Census LUCA Respondent Guide, Digital Address List Format	Large Format Paper Maps only Map Sheet Relationship List
Digital/Paper PDF	Digital Address List on one data disc 2020 Census LUCA Respondent Guide, Digital Address List Format	Large Format Paper Maps and the PDF Small Format Maps are included on the same data disc as the Address List
Digital/Digital	Digital Address List on one data disc 2020 Census LUCA Respondent Guide, Digital Address List Format	Digital Maps are on a separate data disc than the Address List and a separate disc contains the courtesy software installation for the GUPS 2020 Census LUCA Respondent Guide, Instructions for Using the Geographic Update Partnership Software (GUPS)

Sources: The 2020 Census LUCA Respondent Guide, Paper Address List Format; The 2020 Census LUCA Respondent Guide, Digital Address List Format.

Participating entities reviewed their materials and provided the Census Bureau with their updates. The entities could take Add, Change, Delete, Out of Jurisdiction, and Nonresidential actions on their address lists, which contained all the residential (city-style and non-city-style) addresses known to the Census Bureau within the entities. Table 4 shows the address actions that participants could take for LUCA.

Table 4. LUCA Participant Actions

Action Code	Action	Description Provided to the Entities
A	Add	Residential addresses for your jurisdiction not shown on the Census Address List
C	Change	Correction to this address
D	Delete	Delete this address
J	Out of Jurisdiction	Address is not in this jurisdiction
N	Nonresidential	Address is nonresidential

Source: The 2020 Census Local Update of Census Addresses Operation (LUCA) Respondent Guide, Paper Address List Format.

The participating entities could also update the geographic location of the addresses providing the census tabulation block and/or the geographic coordinate (latitude and longitude).
If participants reviewing the materials had additional questions, they could refer to the LUCA Respondent Guide included in the materials, view LUCA operation training videos, access the LUCA operation online Frequently Asked Questions, or personally contact the Geographic Partnership Support Desk (GPSD).

2.4.1.5 Geographic Partnership Support Desk

The GPSD was responsible for answering questions from participants regarding their LUCA operation materials. Census Bureau staff provided training and documentation for the GPSD staff. The GPSD maintained a call log identifying who took the call; the date and time of the call; the entity ID, regional office (RO), entity name, entity state; first and last name and phone number of the participant making the call; a description of the problem; whether the problem was closed, and if closed, the date closed, and if not closed, the status of the problem.

The GPSD was comprised of three tiers:

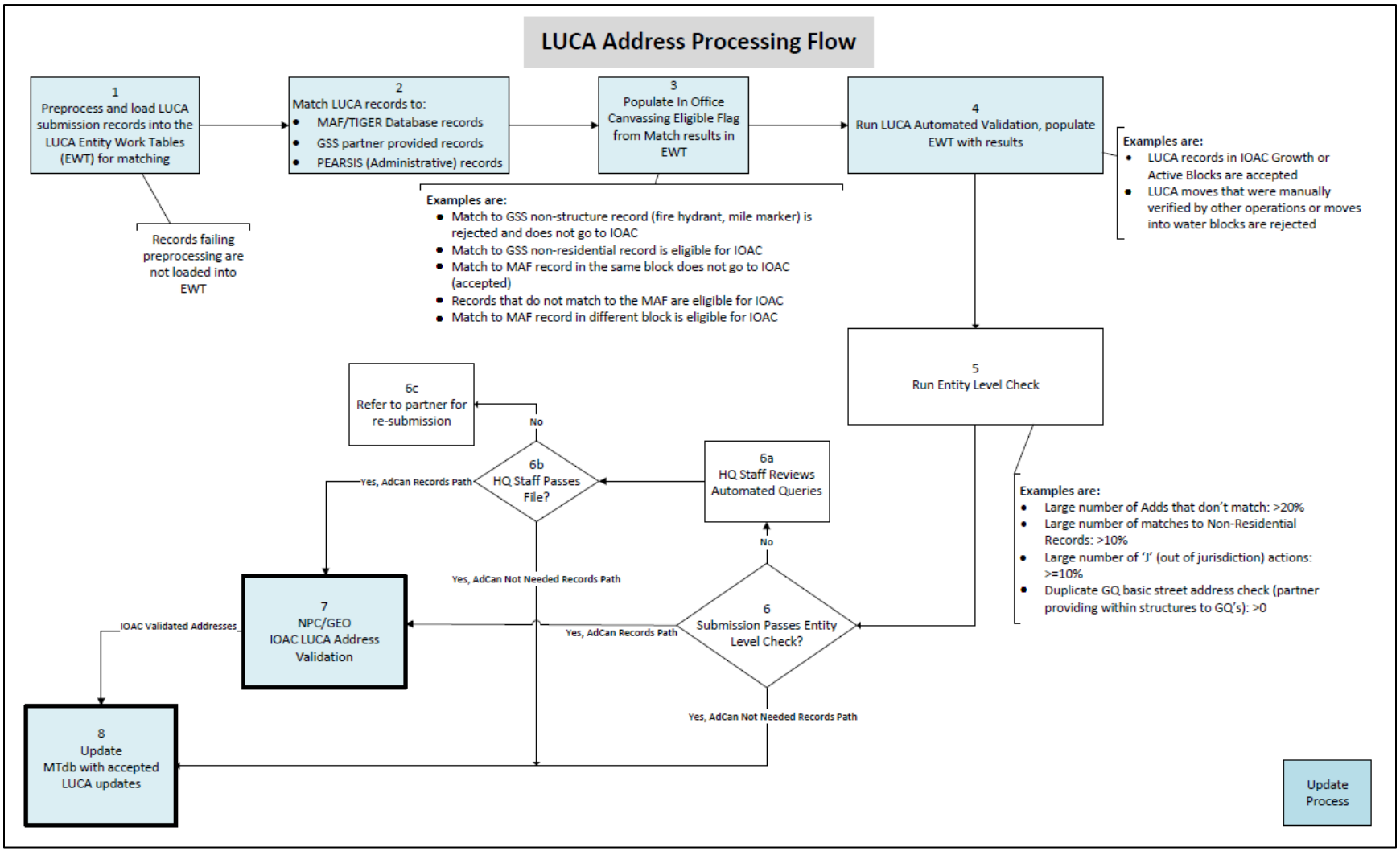
- Tier 1 was located at the National Processing Center (NPC) and staffed by NPC clerks. The Tier 1 support desk primarily handled questions from smaller entities and nontechnical questions, such as supplying lost passwords, updating contact information, or other calls following scripts.
- Tier 2 was also located at NPC and staffed by geographic specialists. The Tier 2 support desk was responsible for trouble-shooting more complex technical questions.
- Tier 3 was comprised of RO geographers and Census Bureau staff. When the Tier 1 and Tier 2 NPC support staff could not answer a participant's inquiry, they transferred the participant to staff either at the RO, RCC, or at GEO, located at Census Bureau headquarters. Tier 3 staff was also responsible for responding to calls and entering information from the larger entities, such as states, larger cities from tribal entities, and Puerto Rico.

2.4.2 LUCA Materials Processing

All LUCA submissions, whether paper or digital, went through a process to verify and validate the data before Census Bureau used them to update the MAF/TIGER database. The processing steps include Initial Material Review, Preprocessing, Matching and Automated Validation, Entity Level Checks, In-Office Address Canvassing LUCA Address Validation, and MAF Updating.

Figure 1 shows the high-level processing flow for the LUCA operation.

Figure 1. LUCA Address Processing Flow



Source: 2020 LUCA operation, GEO.

2.4.2.1 Initial Material Review

NPC staff received and reviewed both the paper submissions and the digital submissions, which came in either on a CD/DVD or digitally through the Secure Web Incoming Module (SWIM) system, to ensure each submission was complete. NPC keyed the data from paper submissions using GUPS into the same format as the digital submissions. In instances where NPC found significant errors in a LUCA submission, they informed the staff in the ROs or RCCs who followed up with participating entity to correct their submission. If more than 10 percent of an entity's address list had any issues, the submission was referred for a follow-up with the entity that provided the submission. If under 10 percent of an entity's addresses had issues, the Census Bureau removed the problematic records and sent the remaining addresses downstream.

2.4.2.2 Preprocessing of the LUCA Address Submissions

Once NPC confirmed a LUCA submission as complete, it was loaded into entity-based LUCA Worktables, then the LUCA Master Table through an automated process. As part of the load process, the Census Bureau performed automated preprocessing to remove invalid address records from downstream processing. Preprocessing edits identified address records where the latitude and longitude coordinates could not be derived from the data provided; the address failed legal value checks; an address duplicated exactly another address record in the submission; or the address contained invalid address data.

2.4.2.3 Matching LUCA Address Submissions

The Census Bureau collected local GIS address files and evaluated the address records for accuracy as part of the GSS during the 2013–2017 timeframe. To take advantage of the evaluation conducted as part of the Address Source Evaluation (ASE), the Census Bureau matched LUCA participant entity address files against the evaluated GSS address files. If address records matched to a record determined to be nonresidential or was rejected as part of ASE, the LUCA record was rejected. The Census Bureau also matched records against the Production Environment for Administrative Records, Staging, Integration and Storage (PEARSIS) and MAF/TIGER databases. The results of matching LUCA addresses to GSS, MTDB, PEARSIS, and other sources allowed certain LUCA records to bypass in-office validation.

2.4.2.4 Entity Level Checks

The Entity Level Checks were run as part of an automated batch process composed of several queries to identify and mitigate potential errors from being introduced into the MAF by the participating LUCA entities. The edits checked for a variety of situations including house numbers and within-structure identifiers (IDs) that differed from the original record value because the participating entities were not supposed to edit those fields; a large number of adds with a very low match rate to MAF/TIGER; different state and county codes from the

original record values; GQs with the same basic street address (house number and street name); and duplicates among the added records.

2.4.2.5 LUCA Matching and Address Validation

The LUCA Address Validation component of In-Office Address Canvassing (IOAC) consisted of an in-office review of LUCA addresses submitted by the participating entities that were not validated through the automated match to the MAF and other designated records.

The LUCA Address Validation universe consisted of the following LUCA address records:

- Participant Add actions that did not match to an existing GSS MAF/TIGER record.
- Participant Add actions that matched to MAF/TIGER but the LUCA participant located the record in a different block.
- Participant Change actions where the LUCA participant moved an address into a different block than the existing address record in MAF/TIGER.
- Participant Records that matched to a nonresidential address in the MAF.

LUCA Address Validation did not adjust any participant address components. The process only determined if an address record existed or if the MAF version was more spatially accurate. LUCA Address Validation reviewers also determined whether the address record belonged in a block other than the block indicated by the LUCA participant or MAF. For more information about LUCA Address Validation, refer to the 2020 Census In-Office Address Canvassing Operational Assessment Report (Richmond and Hanks, 2022).

Once the Census Bureau completed address validation for all LUCA address records, LUCA address records were updated in the MAF/TIGER System based on the results of LUCA matching and/or the Address Canvassing operation, as appropriate.

2.4.2.6 Processing of LUCA Features Updates

When NPC received the paper map submissions, NPC staff updated the Production Control System (PCS) and reviewed the maps. If the reviewer had no questions, they digitized any new or updated road features into the Geographic Aquis-based Topological Referencing and Encoding System (GATRES) within the MAF/TIGER System. Reviewers used any new map spots to verify the location of the addresses on the LUCA address list.

When NPC received digital shapefile submissions, NPC staff updated the PCS. Next, NPC staff checked the participant CD/DVD submissions for viruses and prepared the shapefiles. NPC staff digitized the linear feature updates directly in the MAF/TIGER System when there were 25 or

fewer changes. If there were more than 25 changes, the updates were inserted through conflation, an automated change detection and batch update process.

2.4.3 LUCA Feedback and Appeals

In August of 2019, the Census Bureau provided feedback to LUCA participants unless they opted out of LUCA Feedback. Participating entities received their feedback materials in the same media format that they requested for their LUCA review materials. Participants received a Detailed Feedback Address List that showed each address record processed by the Census Bureau and a Feedback action code that identified a specific action taken by the Census Bureau on that address record. The Detailed Feedback Address List also identified addresses deleted in other census operations. Table 5 shows the feedback codes used during the LUCA operation.

Table 5. LUCA Feedback Codes

Feedback Code	Eligible Participant Actions	Description
A01	A, C	**Address is in the 2020 Census in the same block** The Census Bureau included this address in the 2020 Census for your jurisdiction in the same block and accepts your LUCA update.
A02	A, C	**Address is in the 2020 Census in a different block** The Census Bureau included this address in the 2020 Census for your jurisdiction in a different block and accepts your LUCA update.
A03	D, J, N	**Address is not in the 2020 Census** The Census Bureau excluded this address from the 2020 Census for your jurisdiction and accepts your LUCA update.
R01	A, D, J, N	**Address is in the 2020 Census in the same block** The Census Bureau included this address in the 2020 Census for your jurisdiction in the same block and rejects your LUCA update.
R02	D, J, N	**Address is in the 2020 Census in a different block** The Census Bureau included this address in the 2020 Census for your jurisdiction in a different block and rejects your LUCA update.
R03	A, C	**Address is not in the 2020 Census** The Census Bureau excluded this address from the 2020 Census for your jurisdiction and rejects your LUCA update.
X01	A, C, D, J, N	**Address removed from the 2020 Census** The Census Bureau excluded this address from the 2020 Census for your jurisdiction. This address was NOT updated as part of your LUCA review but has been deleted from the 2020 Census Address list by a different census operation or another level of government participating in LUCA.

Source: 2020 Census Local Update of Census Addresses Operation (LUCA) Feedback and Appeals Respondent Guide.

The Census Bureau provided an X01 code to entities participating in LUCA Feedback if another entity participating in LUCA or another census operation deleted a record. For example, if a

state and place level government were both participants in LUCA and the state level government deleted a record falling within the jurisdictional boundary of the place, the place would have received that record on their LUCA feedback address list as an X01 record. The place then had the opportunity to appeal the deletion of the record. Additionally, had another census operation deleted a record falling with the jurisdictional boundary of the state and place level government, both would have received that address on their LUCA feedback address list. The X01 records were stored in a separate table from the LUCA Master Table.

LUCA entities had 45 calendar days to file an appeal with the OMB LUCA Appeals Office. Upon receipt of a LUCA appeals submission, the LUCA Appeals Office used the entity's supporting documentation to decide whether to accept or reject the appeal. When OMB completed its review of the LUCA appeals submission, they notified the entity of its determination. The LUCA Appeals Office delivered accepted LUCA appeals to the Census Bureau to process.

2.4.4 Enumeration of LUCA

Addresses that were validated during LUCA or successfully appealed during the Appeals process were included in the 2020 Census enumeration process. Accepted HUs, GQs and TLs from LUCA were included in the enumeration extract to be enumerated through Self-Response Mailings, Update Leave, GQ Enumeration via GQ Advanced Contact and Enumeration of TLs via TL Advanced Contact. Appealed HUs were delivered to the Self-Response Mailings or Update Leave in the supplemental Nonresponse Followup enumeration extract, while Appealed GQs and TLs were loaded into the GQ Production Control System and sent to either GQ or TL Advance Contact. Any nonresponding housing units were then sent to Nonresponse Followup.

2.4.5 Systems and Tools in LUCA

Table 6 lists the primary systems used to support the LUCA operation.

Table 6. List of Main Systems Supporting LUCA

System	Description
GQPCS (Group Quarters Production Control System)	GQPCS controls and monitors the workflow and progress of records for group quarters.
GPP (Geographic Program Participant System)	GPP is a Census Bureau database that records information about contact information for governmental units.
GUPS (Geographic Update Partnership Software)	GUPS is a software tool that enables the collection of geographic updates from participants. GUPS was provided to the LUCA participants and was used to update the LUCA address and spatial data provided for participant review. GUPS allowed partners to produce updated submission files that were returned to the Census Bureau. GUPS is designed for all levels of use and has customized tools for each update program or project that uses it.

System	Description
MaCS (Matching and Coding Software)	MaCS is a system used by clerical staff to match and/or geocode various types of address records. Its base functionality was the starting point for multiple projects, such as In-Office Address Canvassing GQ/TL Review and LUCA Address Validation. MaCS was customized for each individual operation but included modules of functionality that were used by multiple operations such as matching against MAF and TIGER extracts, searches of administrative records, and a mapping utility.
MAF/TIGER (Master Address File/ Topologically Integrated Geographic Encoding and Referencing System)	The MAF/TIGER System provided the address list, map data, geocoding services, and the distribution of related geographic and address products either by electronic or paper means. Specific components of MAF/TIGER used during LUCA included: **GATRES** (Geographic Acquis-based Topological Real-time Editing System) GATRES is a Census Bureau system within MAF/TIGER that is used to interactively update information in the MAF/TIGER System. GATRES allows concurrent access to the MAF/TIGER System by multiple simultaneous interactive users and is accessible from multiple sites, including the Census Bureau regional offices and National Processing Center (NPC). **MAF Browser** MAF Browser is a software tool within the MAF/TIGER System that allows a user to easily search the complex MAF database and return filtered results in a web browser. **MTAG (MAF/TIGER Address Geocoding Application)** MTAG is a part of the MAF/TIGER System that was primarily used to help resolve ungeocoded, residential MAF addresses from the DSF.
PCS (Production Control System)	PCS controls and monitors the workflow and progress of materials for program participants. This system has the same look and feel for all Geographic Partnership Programs.
PEARSIS (Production Environment for Administrative Records, Staging, Integration and Storage)	An aggregated Census Bureau file of more than 26 billion administrative records, including housing unit and person data records from hundreds of data sources. Data have been quality checked, normalized, and standardized.
SWIM (Secure Web Incoming Module)	SWIM is a tool for U.S. Census Bureau partners to send their geospatial data to a Census Bureau server.

Source: 2020 LUCA operation.

3. Assessment Methodology

All 2020 Census operational assessments share a similar methodology. In general, they provide details about the implementation of individual operations and processes (including final volumes, rates, and costs) by presenting data from production systems, files, and activity reports, in addition to information collected from lessons learned and debriefings sessions. These important measures are key ingredients to defining successful completion of the 2020 Census operations and processes. Typical categories of success measures are as follows:

- **Process Measures** that indicate how well the process works, typically including measures related to completion dates, rates, and productivity rates.
- **Cost Measures** that drive the cost of the operation and comparisons of actual costs to planned budgets. Costs can include workload as well as different types of resource costs.
- **Quality Measures** of operational results, typically including things such as rework rates, error rates, and coverage rates.

In addition to planning and managing the implementation of its operation, each Integrated Project Team (IPT) had the responsibility of determining the assessment questions for its operation. In consultation with the Decennial Research Objectives and Methods (DROM) Working Group, each IPT developed assessment questions tailored to the uniqueness of its operation that would yield the most useful information to those planning similar operations in the future. Assessment questions provide the framework for the Results Section appearing in each operational assessment report.

The sections that follow present the assessment questions for this operation and describe the sources of information used to answer them. Please note that the numbers appearing in this operational assessment report have been subjected to the U.S. Census Bureau's approved disclosure avoidance techniques including noise injection and rounding.

3.1 Assessment Questions

This operational assessment answers the following research questions:

1. How many eligible entities were mailed Advance Notice packages?
2. How many eligible entities were invited to participate in LUCA, responded either by registering or declining to participate, or did not respond to the Census Bureau?
3. What were the original and final material choices for the registered entities?
4. How were review material packages shipped?
5. How many registered entities did not submit updates?
6. How many entities were granted extensions?
7. How many entities submitted updates past their due date without receiving an extension, and how many of the late submissions were processed?
8. How many entities submitted updates and what were the types of updates that were submitted?
9. How many address updates were submitted by more than one entity?
10. How many entities submitted GQs and TLs?
11. How many of the addresses were processed and what were the reasons addresses were not processed?
12. What are the results from LUCA addresses being matched to GSS, PEARSIS, and MAF/TIGER?
13. What are the outcomes of the Entity Level Checks and how many entities and records failed Entity Level Checks?

14. What are the results of LUCA Address Validation?
15. What are the results of MAF Updating for Add actions?
16. What are the results of MAF Updating for Change actions?
17. What are the results of MAF updating for Delete, Out of Jurisdiction, and Nonresidential actions?
18. How many ungeocoded address records sent to state and county governments were returned with geocodes?
19. How many LUCA entities submitted spatial updates and how were they processed?
20. How many total GQs and TLs were processed?
21. How many entities received feedback, opted out of receiving LUCA feedback, and were ineligible to receive feedback?
22. How many LUCA addresses were assigned a feedback code and which codes did they receive?
23. What were the enumeration results for LUCA addresses?
24. What were the results of the appeals process?
25. What were the enumeration results for LUCA Appealed addresses?
26. How many phone calls from entities were received by the Help Desk and by the RCCs and what was the nature of the calls?
27. How did the budgeted costs compare with the actual costs in the 2020 LUCA budget?

3.2 Data Sources and Calculations: Production Systems / Reports

The LUCA operation relied on data from various sources to answer the assessment questions. Operational data were extracted primarily from the LUCA Master Table (LMT) and the LUCA PCS, which allowed the LUCA program to store and track operational data. Specific source tables appear with question results, when applicable. The LMT contained every LUCA address record submitted for processing by NPC and included fields of data denoting each address's path through LUCA processing. The PCS contained entity-level data about mailouts, registration, and the entity's submission, and tracked the number of records at the various steps in LUCA processing as updated in the LMT.

Analysis data also came from MAF/TIGER (including MAF extract products), the tables containing Entity-Level data checks, and the GQ PCS system. The GQ PCS provided data specific to GQ and TL results. Data from the MaCS system, tabulation block tables, and basic collection unit (BCU) tables provided data to analyze LUCA Address Validation outcomes.

The OMB LUCA Appeals report provided data about appeal process metrics. The 2020 Census Integrated Master Schedule provided schedule data and the Decennial Budget Office (DBO) produced data regarding operational costs by division and fiscal year.

3.3 Lessons Learned

The LUCA IPT held several meetings to discuss Lessons Learned. Participants included division managers, project managers, subject matter experts, NPC staff, and other staff who designed

the workflows, participated in software development, and/or worked on the operation. Questions typically included the following:

- What successes did the operation have?
- What were challenges and areas that needed improvement for the next operation?
- What are your recommendations for the future?

After compiling data for the operational assessment, key LUCA stakeholders met again to review and finalize Lessons Learned and recommendations. Finally, the Decennial Census Management Division (DCMD) LUCA team gathered all the lessons learned and put them into a standard format, grouped common lessons learned shared across components, and organized them into topics for final IPT review.

4. Limitations

The LMT was a dynamic table used to store submitted data from LUCA participants and some of the IOAC values were removed after the LUCA Address Validation MaCS data were posted to the LMT. Therefore, some addresses were not able to be accounted for in this LUCA Address Validation analysis. Less than 1 percent of addresses were affected by this issue.

For LUCA Address Validation analysis, in order for staff to compile the data across multiple vintages and types of geography, they used a query that picks a single Type of Enumeration (TEA) value for each census block. In actuality, some of the blocks worked in LUCA Address Validation have multiple TEA values since they were split by multiple basic collection units (BCUs).

5. Results

5.1 How many eligible entities were mailed Advance Notice packages?

Table 7 shows the number of Advance Notice Packages mailed to entities by entity type and size.

Table 7. Entities Mailed Advance Notice Packages for the 2020 LUCA Operation

	Total	Entity Size Percent	AIA	ST	CO	MCD	PL
Advance Notice Packages Mailed	39,246*	100.0	332	52	3,112	16,271	19,479
			0.8%	0.1%	7.9%	41.5%	49.6%
1,000 or Fewer Addresses	23,934	61.0%	258	0	72	11,414	12,190
			1.1%	-	0.3%	47.7%	50.9%
1,001 – 6,000 Addresses	9,761	24.9%	59	0	777	3,978	4,947
			0.6%	-	8.0%	40.8%	50.7%
6,001 – 50,000 Addresses	4,787	12.2%	14	0	1,783	855	2,135
			0.3%	-	37.2%	17.9%	44.6%
50,001 – 100,000 Addresses	375	1.0%	1	0	228	20	126
			0.3%	-	60.8%	5.3%	33.6%
100,001 – 1,000,000 Addresses	344	0.9%	0	16	246	4	78
			-	4.7%	71.5%	1.2%	22.7%
1,000,000 or More Addresses	45	0.1%	0	36	6	0	3
			-	80.0%	13.3%	-	6.7%

Source: 2020 LUCA Production Control System (LUCA2020_ADVANCE_NOTICES table).
Numbers may not sum because of rounding.
* The universe for the advance notice mailing was 39,246. After this universe was created, it was discovered that 81 entities were missing from the universe. The 81 entities were included in the invitation mailing, therefore increasing the invitation mailing universe to 39,327.

The Census Bureau sent Advance Notice Packages to 39,246 entities considered eligible to participate in LUCA for the 2020 Census. The table shows that 85.9 percent of the entities sent Advance Notice packages had 6,000 addresses or fewer, and that MCDs and places made up 91.1 percent of the entities sent Advance Notice packages. For comparison, 86.5 percent of eligible entities for the 2010 operation included 6,000 or fewer addresses, and the same percentage—91.1 percent—of 2010 eligible entities consisted of MCDs and places. Entities considered states for purposes of data presentation included the 50 states, the District of Columbia, and Puerto Rico. For the 2010 Census LUCA operation, the Census Bureau considered the District of Columbia as a place.

5.2 How many eligible entities were invited to participate in LUCA, responded either by registering or declining to participate, or did not respond to the Census Bureau?

The LUCA operation used the 2020 LUCA Production Control System containing all entity-level data, to track the number of eligible entities that were invited to participate in LUCA. The

operation tracked the number of entities by invitation, registration, and participation. Table 8 shows the entities invited to participate in LUCA and their response outcomes by entity type.

Table 8. Entities Invited to the 2020 LUCA Operation and Response

	Total	Percent	AIA	ST	CO	MCD	PL
Invited Entities	39,327	100.0%	356	52	3,113	16,315	19,491
			0.9%	0.1%	7.9%	41.5%	49.6%
Registered Entities	11,549	29.4%	146	47	1,866	2,198	7,292
			1.3%	0.4%	16.2%	19.0%	63.1%
Incomplete Registration	13	0.0%	1	0	0	3	9
			7.7%	-	-	23.1%	69.2%
Declined to Participate	8,600	21.9%	10	1	385	4,414	3,790
			0.1%	0.0%	4.5%	51.3%	44.1%
Did Not Respond	19,165	48.7%	199	4	862	9,700	8,400
			1.0%	0.0%	4.5%	50.6%	43.8%

Source: 2020 LUCA Production Control System (PCSPRO.LUCA2020_INVITATIONS, with INV_SENT_DT).

The advance notice mailing universe included 39,246 entities. After creating this universe, the Census Bureau discovered 81 missing entities because of an error with the initial criteria used to define the list of eligible governments, increasing the invitation mailing universe to 39,327. For comparison, the Census Bureau invited 39,329 eligible entities to participate in the LUCA operation for the 2010 Census.

The LUCA operation received responses from 51.3 percent of invited entities. Of these, 29.4 percent of entities registered to participate, and 21.9 percent declined to participate. In 2010, 29.2 percent of the eligible entities registered for participation and 10.8 percent officially declined to register for the program.

Including Puerto Rico and Washington, D.C., 90.4 percent of states registered to participate. In 2010, 28 of the 51 eligible states (including Puerto Rico), or 54.9 percent, registered to participate. The 2020 LUCA team managed a coordinated effort with the regional census centers and the Office of Congressional and Intergovernmental Affairs to encourage state-level governments to participate in LUCA. This effort meant to ensure maximum coverage so that state-level governments could fill in the gaps where local governments did not participate.

Fully registered 2020 entities completed all registration steps and completed and submitted all four required forms, which included the Confidentiality Agreement, the Security Checklist, the Registration, and the Product Preference. Of invited entities, 48.7 percent did not respond and less than 0.1 percent failed to register completely. While LUCA did not have a specific numeric goal for registrations, 47 state governments registered to participate. LUCA participation, therefore, covered more than 90 percent of the country because each registered state had the option of commenting on and/or adding addresses for the entire state.

Table 9 shows the number of AIA invitations and responses by the number of addresses for each entity.

Table 9. American Indian Area (AIA) Invitations and Responses by Number of Addresses

	Invited	Percent	Registered	Incomplete Registration	Declined to Participate	Did Not Respond
Total AIAs	357		146	1	10	199
			40.9 %	0.3%	2.8%	55.7%
1,000 or Fewer Addresses	283	79.3%	102	0	7	174
			35.8%	-	2.5%	1.7%
1,001 – 6,000 Addresses	59	16.5%	39	1	1	18
			66.1%	1.7%	1.7%	30.5%
6,001 – 50,000 Addresses	14	3.9%	5	0	2	7
			35.7%	-	14.3%	50.0%
50,001 – 100,000 Addresses	1	0.3%	1	0	0	0
			100.0%	-	-	-
100,001 – 1,000,000 Addresses	0		0	0	0	0
			-	-	-	-
1,000,001 or More Addresses	0		0	0	0	0
			-	-	-	-

Source: 2020 LUCA Production Control System (LUCA2020_INVITATIONS table - Y, N, Null or the entity had incomplete registration).

Of the 357 AIA entities that the Census Bureau invited to participate, 40.9 percent registered for LUCA and 55.7 percent did not respond to the invitation to participate. Although the largest percentage of AIAs only contain 1,000 or fewer addresses (79.3 percent), only 35.8 percent of those entities registered to participate.

Table 10 shows the state and state-equivalent invitations and responses by address size class. In 2020 LUCA, 32 states or state-equivalents[4] with 1,000,001 or more addresses registered to participate, compared with 19 states or state-equivalents in 2010.

Table 10. States and State Equivalents Invitations and Responses by Number of Addresses

	Invited	% Of Invited	Registered	Incomplete Registration	Declined to Participate	Did Not Respond
Total States	52*	100.0%	47	0	1	4
			90.4%	-	1.9%	7.7%
100,001 – 1,000,000 Addresses	16	30.8%	15	0	1	0
			93.8%	-	6.3%	-
1,000,001 or More Addresses	36	69.2%	32	0	0	4
			88.9%	-	-	11.1%

Source: 2020 LUCA Production Control System (LUCA2020_INVITATIONS table - Y, N, Null or the entity had incomplete registration).
*The state count for LUCA is 52 because of the District of Columbia and Puerto Rico being in the LUCA universe.

[4] In addition to the 50 states, the Census Bureau treats the District of Columbia, Puerto Rico, American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands as the statistical equivalents of states for the purpose of data presentation. The 50 states, the District of Columbia, and Puerto Rico were eligible for the 2020 LUCA operation.

Table 11 shows the county and county-equivalent invitations and responses by address size class.

Table 11. County or County Equivalents Invitations and Response by Number of Addresses

	Invited	Percent of Invited	Registered	Incomplete Registration	Declined to Participate	Did Not Respond
Total Counties	3,113		1,866	0	385	862
			59.9%	-	12.4%	27.7%
1,000 or fewer Addresses	72	2.3%	18	0	20	34
			25.0%	-	27.8%	47.2%
1,001 – 6,000 Addresses	777	25.0%	325	0	141	311
			41.8%	-	18.1%	40.0%
6,001 – 50,000 Addresses	1,784	57.3%	1,103	0	207	474
			61.8%	-	11.6%	26.6%
50,001 – 100,000 Addresses	228	7.3%	196	0	10	22
			86.0%	-	4.4%	9.6%
100,001 – 1,000,000 Addresses	246	7.9%	218	0	7	21
			88.6%	-	2.8%	8.5%
1,000,001 or More Addresses	6	0.2%	6	0	0	0
			100.0%	-	-	-

Source: 2020 LUCA Production Control System (LUCA2020_INVITATIONS table - Y, N, Null or the entity had incomplete registration).

Of all invited counties or county-equivalent entities, 59.9 percent registered to participate compared with 51.2 percent (1,596 out of 3,115 eligible) registering in 2010. Larger counties participated more often than smaller counties. For example, only 25.0 percent of counties with 1,000 or fewer addresses registered to participate, while 88.6 percent of counties with 100,001 to 1 million addresses registered and all six counties with more than 1 million addresses registered.

Table 12 shows MCD invitations and responses by the number of addresses in each MCD.

Table 12. Minor Civil Divisions (MCDs) Invitations and Response by Number of Addresses

	Invited	Percent of Invited	Registered	Incomplete Registration	Declined to Participate	Did Not Respond
Total MCDs	16,315		2,198	3	4,414	9,700
			13.5%	0.0%	27.1%	59.5%
1,000 or Fewer Addresses	11,453	70.2%	946	1	3,165	7,341
			8.3%	0.0%	27.6%	64.1%
1,001 – 6,000 Addresses	3,982	24.4%	915	1	1,069	1,997
			23.0%	0.0%	26.8%	50.2%
6,001 – 50,000 Addresses	856	5.2%	333	1	172	350
			38.9%	0.1%	20.1%	40.9%
50,001 – 100,000 Addresses	20	0.1%	3	0	5	12
			15.0%	0.0%	25.0%	60.0%
100,001 – 1,000,000 Addresses	4	<0.1%	1	0	3	0
			25.0%	0.0%	75.0%	0.0%
1,000,001 or More Addresses	0	0.0%	0	0	0	0

Source: 2020 LUCA Production Control System (LUCA2020_INVITATIONS table - Y, N, Null or the entity had incomplete registration).

Of the 16,315 MCDs invited, only 13.5 percent (2,198) registered to participate, compared with 16.7 percent (2,753 out of 16,440) in 2010. In 2010, MCDs represented the second highest number of government types but had the lowest percentage of registration (Swartz et al., 2012). During the 2020 operation, although 70.2 percent of the invited MCDs contained 1,000 or fewer addresses, only 8.3 percent (946 our 11,453) registered to participate.

Table 13 shows details about MCDs.

Table 13. Number of MCDs Invited to Participate and Registered by State

	Invited to Participate	Registered	Percent Registered
State	16,315	2,198	13.5%
Connecticut	149	60	40.3%
Illinois	1,428	69	4.8%
Indiana	1,005	35	3.5%
Kansas	1,273	13	1.0%
Massachusetts	298	246	82.6%
Maine	466	57	12.2%
Michigan	1,240	244	19.7%
Minnesota	1,781	147	8.3%
Missouri	299	5	1.7%
Nebraska	392	4	1.0%
New Hampshire	221	64	29.0%
New Jersey	241	85	35.3%
New York	929	203	21.9%
North Dakota	1,312	56	4.3%
Ohio	1,308	83	6.4%
Pennsylvania	1,546	542	35.1%
Rhode Island	31	12	38.7%
South Dakota	907	34	3.8%
Vermont	237	56	23.6%
Wisconsin	1,252	183	14.6%

Note: Not all states contain MCDs.
Source: LUCA Production Control System.

Connecticut, Massachusetts, New Jersey, Pennsylvania, and Rhode Island had the highest percentage of MCDs register to participate in LUCA. Each of these states, located generally in the northeastern portion of the country, had rates of registration at 35 percent or higher. Table 14 shows the invitations and response rates for incorporated places by number of addresses.

Table 14. Incorporated Places Invitations and Response

	Invited	Percent of Invited	Registered	Incomplete registration	Declined to Participate	Did Not Respond
Total Places	19,491		7,292	9	3,790	8,400
			37.4%	0.0%	19.4%	43.1%
1,000 or Fewer Addresses	12,201	62.6%	3,212	7	2,727	6,255
			26.3%	0.1%	22.4%	51.3%
1,001 – 6,000 Addresses	4,947	25.4%	2,337	2	840	1,768
			47.2%	0.0%	17.0%	35.7%
6,001 – 50,000 Addresses	2,137	11.0%	1,553	0	214	370
			72.7%	-	10.0%	17.3%
50,001 – 100,000 Addresses	126	0.6%	116	0	3	7
			92.1%	-	2.4%	5.6%
100,001 – 1,000,000 Addresses	77	0.4%	71	0	6	0
			92.2%	-	7.8%	-
1,000,001 or More Addresses	3	0.0%	3	0	0	0
			100.0%	-	-	-

Source: 2020 LUCA Production Control System (LUCA2020_INVITATIONS table - Y, N, Null or the entity had incomplete registration).

Places with higher numbers of addresses participated more frequently than places with lower numbers of addresses. For example, 26.3 percent of counties with 1,000 or fewer addresses registered, while 92.1 percent of counties with 100,001 to 1 million addresses and 92.2 percent of counties with more than 1 million addresses registered to participate. Of incorporated places invited to participate, 37.4 percent registered, which is similar to 2010 when 36.1 percent of places (7,009 out of 19,392) registered to participate. During the 2010 LUCA operation 11,500 entities registered and places represented the highest number and percentage of registrants at 7,009 or 60.9 percent.

Table 15 shows reasons that entities cited for not participating in LUCA.

Table 15. Reasons Entities Cited for Not Participating.

	Count	Percent
Reasons that entities cited for declining to participate	885	100.0%
Another entity or organization participated on behalf of the entity	133	15.0%
Insufficient staff	38	4.3%
Lack of funds	5	0.6%
Not enough time or too busy	4	0.5%
No local address list	46	5.2%
Concern for Title 13	11	1.2%
Restriction of Title 13 usage	3	0.3%
Other reason	503	56.8%
Multiple reasons	142	16.0%
Total number of governments who cited either or both Title 13 reasons	0	0.0%

Source: 2020 LUCA Production Control System (LUCA2020_INVITATIONS table - N: participant responded with No, Null: no response or the entity had incomplete registration).

Though the LUCA operation attempted to collect reasons for lack of participation, 89.7 percent of entities did not provide a reason.

During the 2010 LUCA operation, governments were asked to select a reason or reasons from a checklist for their decision not to participate as part of the invitation and registration process. The 2020 checklist appeared on the registration form, rather than as a separate survey. As a result, the 2020 and 2010 data are difficult to compare. Of the 4,239 governments that indicated their decision not to participate in the 2010 LUCA operation, 4,125 governments provided reasons for their decision and 114 respondents provided no reason. Although 4,125 governments provided reasons, some governments selected multiple reasons, resulting in 9,345 total responses.

5.3 What were the original and final material choices for the registered entities?

Participating LUCA entities had choices to use different types of materials for review and updates (see Table 3 for the list of material types). **Error! Reference source not found.** shows the total number of materials that entities selected by original and final choice.**Error! Reference s ource not found.** Table 16 shows the original and final material choices by entity type and Table 17 shows the original and final LUCA materials choices by entity size.

Table 16. Original and Final Material Choices for Registered LUCA Entities by Type.

Material Choice	Status	AIA	ST	CO	MCD	PL	Total	Change
Paper/Paper	original	8	0	23	487	1,074	**1,592**	
	Final	8	0	25	495	1,104	**1,632**	40
Paper/Paper PDF	original	19	0	33	435	1,212	**1,699**	
	Final	19	0	33	451	1,232	**1,735**	36
Paper/Digital	original	0	0	0	1	9	**10**	
	Final	1	0	0	1	8	**10**	0
Digital/Paper	original	0	0	9	21	54	**84**	
	Final	0	0	6	20	60	**86**	2
Digital/Paper PDF	original	23	0	106	332	1,029	**1,490**	
	Final	23	0	100	333	1,028	**1,484**	-6
Digital/Digital	original	96	47	1,695	922	3,914	**6,674**	
	Final	95	47	1,702	898	3,860	**6,602**	-72
Total							**11,549**	78

Source: 2020 LUCA Production Control System.

Table 17. Original and Final LUCA Materials Choices for Registered LUCA Entities by Size.

Material Choice	Status	1,000 or Fewer Addresses	1,001 – 6,000 Addresses	6,001 – 50,000 Addresses	50,001 – 100,000 Addresses	100,001 – 1,000,000 Addresses	1,000,001 or More Addresses	Total	Change
Paper/ Paper	original	1,201	381	10	0	0	0	**1,592**	
	Final	1,228	392	12	0	0	0	**1,632**	40
Paper/ Paper PDF	original	1,239	453	7	0	0	0	**1,699**	
	Final	1,255	473	7	0	0	0	**1,735**	36
Paper/ Digital	original	6	4	0	0	0	0	**10**	
	Final	6	4	0	0	0	0	**10**	0
Digital/ Paper	original	18	49	17	0	0	0	**84**	
	Final	21	47	18	0	0	0	**86**	2
Digital/ Paper PDF	original	562	673	252	1	2	0	**1,490**	
	Final	563	678	240	1	2	0	**1,484**	-6
Digital/ Digital	original	1,252	2,055	2,708	315	303	41	**6,674**	
	Final	1,204	2,022	2,717	315	303	41	**6,602**	-72
Total								**11,549**	78

Source: 2020 LUCA Production Control System.

Additional data for specific material choices by entities, including percentages, are located in Appendix B in Additional tables related to Question 3

Table 75, Table 76, Table 77, Table 78, Table 79, and Table 80.

Of participating LUCA entities, 57.8 percent opted to use a digital address list and digital maps for their original materials, followed by paper address lists and paper maps at 13.8 percent and digital/paper PDF materials at 12.9 percent. States originally selected only digital/digital materials. While 41.9 percent of MCDs originally selected digital/digital materials, paper/paper and paper/paper PDF options followed at 22.1 percent and 19.8 percent, respectively.

Larger-sized entities more often chose to have digital/digital materials, with only three entities with more than 50,000 addresses chose digital/paper PDF materials. Originally, the Census Bureau did not offer an option for entities with more than 6,000 addresses to receive paper materials. However, the Census Bureau made a special exception for 10 entities that made special requests to receive paper/paper materials, and seven entities to receive paper/paper PDF materials. Of registered entities, 57.2 percent opted to use digital/digital review materials and 14.1 percent chose paper/paper materials as their final choice.

Table 18 shows the entities that changed their LUCA materials option after the receipt of original materials.

Table 18. Entities who Changed Material Option

	Count	Percent
Changed material choice after the receipt of their original chosen material	**167**	
Changed material choice because of their inability to meet Title 13 requirements	0	0.0%
Changed material choice because they found the paper option too excessive or cumbersome	20	12.0%
Changed material choice because they found the digital option too cumbersome or complicated	85	50.9%
Changed material choice because they requested a different address sort type	1	0.6%
Changed material choice because they received damaged products	0	0.0%
Changed material choice for another reason	57	34.1%
Changed material but have not provided any reason (no reason at all)	4	2.4%

Source: 2020 LUCA Production Control System.

The entities shown above may have requested materials changes multiple times, so the table shows a larger number of changes in total than the original and final status tables above. Of all the participating LUCA entities, entities changed their material option 167 times after receiving their original materials. Of entities changing their choice, 85 (50.9 percent) changed from digital materials.

Table 19 shows the number of entities that received materials remailings and the associated reasons.

Table 19. Entities Remailed Materials and Reason for Remail

	Count	Percent
Entities Remailed Materials	**111**	
Original package was destroyed by FedEx	0	0.0%
Natural disaster	0	0.0%
Original package not received by the partner	18	16.2%
Original package damaged	4	3.6%
Original shipment refused by the recipient	0	0.0%
Original shipment was undeliverable as addressed and updated address used for remail	4	3.6%
Other reasons (including ungeocoded addresses, blank disks, missing maps/address lists)	85	76.6%

Source: 2020 LUCA Production Control System.

Table 19 shows that 111 entities required their LUCA review materials to be remailed. The Census Bureau sent 18 (16.2 percent) of the 111 entities a second package because they did not receive the first package, and four entities' packages were returned as undeliverable, so the Census Bureau used an updated address to resend the packages. Many of the 85 entities in the "other reasons" remail category resulted from participants being unable to work with ungeocoded records in GUPS software. As a result, the Census Bureau made changes to allow these records to function in GUPS. Not all participants used GUPS because the software was optimized to handle fewer than 250,000 records. Consequently, only some entities requested a remailing based on GUPS limitations.

5.4 How were review material packages shipped?

Table 20 summarizes how the Census Bureau shipped review material packages to LUCA entities for the 2020 Census.

Table 20. Shipping Methods for Review Material Packages

Shipping Method	Average Cost for Method	Number of Packages	Percentage
Review Materials Packages shipped using exclusively FedEx	$9	10,599	98.0%
Review Materials Packages shipped using exclusively USPS	$8	220	2.0%
Total Review Materials Packages Shipped	-	10,819	100.0%

Source: LUCA Production Control System.

While FedEx averaged a higher cost per package, LUCA required the tracking of both outbound and inbound packages because packages contained Title 13 information. FedEx provided a single software solution known as the FedEx Cafe system. FedEx also provided shipping materials at no extra cost. USPS did not offer one software and package system that allowed for the tracking of both outbound and inbound packages. The Census Bureau may have needed to purchase a Commercial Off the Shelf (COTS) software to support such functionality. As a result, the Census Bureau shipped 98.0 percent of review packages to entities using FedEx, which offered a cost-effective method to meet the operation's needs.

After initially attempting delivery via FedEx, the Census Bureau received several packages sent to Puerto Rico back in the mail as undeliverable. However, the Puerto Rico post offices had local knowledge to deliver the review packages. Consequently, the Census Bureau found USPS to be a useful shipping resource in Puerto Rico. The Census Bureau shipped packages in Alaska (with the exception of the Anchorage area) using a combination of both FedEx and USPS because these companies had cooperative agreements for portions of Alaska. The Census Bureau also sent packages to small towns and MCDs with no physical mailing address using USPS.

5.5 How many registered entities did not submit updates?

Table 21 shows the numbers of registered entities that either did not return their review materials or did not provide any updates in their returned materials, shown by entity size and type. Table 22 shows the numbers of registered entities that did not return their review materials by entity size and product choice. Table 23 shows the numbers of registered entities that did not return their review materials by entity type and product choice.

Table 21. Registered Entities that did not Submit Updates by Entity Type and Entity Size

	Total	Percent	AIA	ST	CO	MCD	PL
Registered	**11,549**		**146**	**47**	**1,866**	**2,197**	**7,293**
			1.3%	0.4%	16.2%	19.0%	63.1%
Did not submit updates	**2,921**	**25.3%**	53	4	337	584	1,943
			1.8%	0.1%	11.5%	20.0%	66.5%
1,000 or Fewer Addresses	1,323	45.3%	37	0	3	298	985
			2.8%	0.0%	0.2%	22.5%	74.5%
1,001 – 6,000 Addresses	1,020	34.9%	14	0	98	215	693
			1.4%	0.0%	9.6%	21.1%	67.9%
6,001 – 50,000 Addresses	532	18.2%	1	0	208	71	252
			0.2%	0.0%	39.1%	13.3%	47.4%
50,001 – 100,000 Addresses	26	0.9%	1	0	17	0	8
			3.8%	0.0%	65.4%	0.0%	30.8%
100,001 – 1,000,000 Addresses	18	0.6%	0	2	11	0	5
			0.0%	11.1%	61.1%	0.0%	27.8%
1,000,001 or More Addresses	2	0.1%	0	2	0	0	0
			0.0%	100.0%	0.0%	0.0%	0.0%

Source: 2020 LUCA Production Control System.

Table 22. Registered Entities that did not Submit Updates by Product Choice and Entity Size

	Total	Percent	Paper/ Paper	Paper/ Paper PDF	Paper/ Digital	Digital/ Paper	Digital/ Paper PDF	Digital/ Digital
Registered	**11,549**		**1,632**	**1,735**	**10**	**86**	**1,484**	**6,602**
			14.1%	15.0%	0.1%	0.7%	12.8%	57.2%
Did not submit updates	**2,921**	**25.3%**	**375**	**485**	**6**	**19**	**424**	**1,612**
			12.8%	16.6%	0.2%	0.7%	14.5%	55.2%
1,000 or Fewer Addresses	1,323	45.3%	300	359	4	5	201	454
			22.7%	27.1%	0.3%	0.4%	15.2%	34.3%
1,001 – 6,000 Addresses	1,020	34.9%	74	125	2	8	165	646
			7.3%	12.3%	0.2%	0.8%	16.2%	63.3%
6,001 – 50,000 Addresses*	532	18.2%	1	1	0	6	58	466
			0.2%	0.2%	0.0%	1.1%	10.9%	87.6%
50,001 – 100,000 Addresses	26	0.9%	0	0	0	0	0	26
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
100,001 – 1,000,000 Addresses	18	0.6%	0	0	0	0	0	18
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
1,000,001 or More Addresses	2	0.1%	0	0	0	0	0	2
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Source: 2020 LUCA Production Control System.

*Entities of this size received a special exception to receive paper materials; a few did not return them.

Table 23. Registered Entities that did not Submit Updates by Product Choice and Entity Type

	Total	Percent	Paper/ Paper	Paper/ Paper PDF	Paper/ Digital	Digital/ Paper	Digital/ Paper PDF	Digital/ Digital
Registered	**11,549**		1,632	1,735	10	86	1,484	6,602
			14.1%	15.0%	0.1%	0.7%	12.9%	57.2%
Did not return review materials	**2,921**	**25.3%**	375	485	6	19	424	1,612
			12.8%	16.6%	0.2%	0.7%	14.5%	55.2%
AIA	53	1.8%	2	7	0	0	10	34
			3.8%	13.2%	0.0%	0.0%	18.9%	64.2%
ST	4	0.1%	0	0	0	0	0	4
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
CO	337	11.5%	8	9	0	1	35	284
			2.4%	2.7%	0.0%	0.3%	10.4%	84.3%
MCD	584	20.0%	128	107	0	4	89	256
			21.9%	18.3%	0.0%	0.7%	15.2%	43.8%
PL	1,943	66.5%	237	362	6	14	290	1,034
			12.2%	18.6%	0.3%	0.7%	14.9%	53.2%

Source: 2020 LUCA Production Control System.

Of registered LUCA entities, 2,921 (25.3 percent) did not return review materials. This figure includes entities that did not return materials and entities that returned materials without updates. Of the 2,921 entities that did not return review materials, 80.2 percent were entities with fewer than 6,001 addresses; 66.5 percent were places; and 20.0 percent were MCDs.

For the 2010 LUCA operation, 10,835 entities could return address and spatial updates. Of these, 8,513 entities submitted returns, 2,322 entities did not submit returns, and 324 entities did not provide updates in their returns.

For 2020, 2,921 LUCA entities did not return materials and had no updates, compared with 2,646 entities in the 2010 LUCA operation. However, the 2010 operation had a different option (Option 3) for entities that did not involve return of materials, which makes direct comparison difficult.

5.6 How many entities were granted extensions?

Participating entities who required an extension beyond the 120-day review period contacted Census Bureau staff at headquarters or regional offices to request extensions, who then submitted all extensions to GEO management for consideration and approval. Entities typically requested one to two weeks of additional time and the requests were approved if the justification supported the extension. In a limited number of circumstances, requests for extensions exceeded two weeks. The Census Bureau only approved these requests in the most extreme circumstances. Often, GEO would counter by proposing a shorter extension of one to two weeks. Table 24 shows the number of entities that received review period extensions and the reasons for these extensions.

Table 24. Entities Granted Extensions and Reason for Extension

	Count	Percent
Entities Granted an Extension	**376**	
Ungeocoded addresses not displaying in GUPS	49	13.0%
Processing limitations in GUPS because the entity had more than 300,000 addresses	0	0.0%
Material shipment delay from the Census Bureau	0	0.0%
Materials remailed to the LUCA Entity	63	16.8%
Request from the LUCA Entity	264	70.2%

Source: 2020 LUCA Production Control System.

The Census Bureau granted 70.2 percent of the extensions for 2020 LUCA at the request of the entity. Entities provided various reasons for needing an extension to complete their review, including staff being out of the office because of an emergency, a natural disaster (such as Hurricane Maria and the wildfires in California), and sometimes entities simply needed more time.

During LUCA GUPS development, the LUCA operation did not anticipate receiving ungeocoded records from entities. As a result, ungeocoded records would not display in GUPS and the operation then needed to adjust for these records to display them in GUPS. Because not all participants used GUPS, only certain entities requested remails and were given more time based on the receipt of the new materials.

5.7 How many entities submitted updates past their due date without receiving an extension, and how many of the late submissions were processed?

Table 25 shows a summary of the number of late materials submitted without an extension granted, including the total number of submissions and the numbers of materials that the Census Bureau did and did not process.

Table 25. Late Material Submissions without an Extension

	Count	Percent
Total Submissions Received	**8,628**	
Late Submissions Received	**1,508**	**17.5%**
Late Submissions Processed	1,146	76.0%
Late Submissions Not Processed	362	24.0%

Source: 2020 LUCA Production Control System / Mail /PROCESS_VERIFY_ADR tables.

The LUCA operation received 1,508 late submissions that made up 17.5 percent of all submissions. Of these, the Census Bureau processed 1,146 (76 percent), and did not process 362 (24 percent). These entities received no formal extension of the submission deadline but the Census Bureau still processed most of the late returns. The returns that the Census Bureau did not process came in too late to be included in the April 2019 update process. However, the

National Processing Center (NPC) continued logging the receipt of submissions, even though they would not be processed (e.g., submissions received in 2019 and 2020).

5.8 How many entities submitted updates and what were the types of updates that were submitted?

Table 26 shows a summary of LUCA entities that returned materials to the Census Bureau by method, including materials with and without updates.

Table 26. LUCA Entities that Returned Materials

	Count	Percent
Submitted Returns	8,628	100.0%
Submitted returns with no updates*	1,778	**20.6%**
Submitted returns with updates	6,850	**79.4%**
Submitted returns with both address and spatial updates**	2,206	32.2%
Submitted returns with address updates only	4,589	67.0%
Submitted returns with spatial updates only	55	0.8%
Entity submissions with addresses***	6,795	99.2%
Submitted digital address submissions	4,623	68.0%
Submitted paper address submissions	2,096	30.8%
Submitted both digital and paper address submissions	76	1.2%

Source: 2020 LUCA Production Control System.
* The percent of returns with updates and without updates was calculated using the number of submitted returns.
** The percentages of returns with both address and spatial updates, only address updates, and only spatial updates were calculated using the number of submitted returns with updates.
*** The percent of Entity Submission with Addresses was calculated from the number of submitted returns with updates.

Of the 8,628 entities that submitted returns, 79.4 percent provided updates and 20.6 percent verified that there were no updates within their review area. Of the 6,850 entities that submitted returns with updates, 99.2 percent contained address updates. Of the 6,795 entities that submitted address updates, 68.0 percent were digital submissions.

During the 2010 LUCA operation, 8,513 participants submitted address and/or spatial updates. Of these, 8,189 (96.2 percent) submitted updates and 8,186 went on for processing after RO or RCC editing. Of these, 2,950 (36.0 percent) participants submitted address updates only, 545 (6.7 percent) submitted spatial updates only, and 4,691 (57.3 percent) submitted both address and spatial updates.

5.9 How many address updates were submitted by more than one entity?

Addresses can fall under the jurisdiction of more than one government and multiple entities may report the same address. For example, a county and a state government could have reported the same address. When this situation occurred, the Census Bureau processed both

records through the validation steps that lead to updating the Master Address File (MAF). The MAF update software used the Multiple Update Hierarchy to determine which address record to use to update the MAF. This hierarchy factored in the entity type, the action provided by each entity, and results of the automated and manual review of the address records from validation. Table 27 and Table 28 show MAF IDs provided by more than one entity and the entity types that submitted these addresses.

Table 27. LUCA MAFIDs Provided by More than One Entity

	Count
Total Addresses	130,000
Distinct MAFIDs	65,000
Distinct Governments	1,435

Source: LUCA Master Table and MAF.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.

Table 28. Addresses Submitted by More than One Entity Shown by Entity Type

Entity Type	Entity Count	Percent of Total Entity Count	Percent of Total Address Count
AIA	25	1.7%	0.5%
State	17	1.2%	18.9%
County	435	30.3%	39.6%
MCD	127	8.9%	1.5%
Place	831	57.9%	39.5%
Total	1,435	100.0%	100.0%

Source: LUCA Master Table and MAF.

LUCA received updates from more than one participating LUCA entity for 130,000 addresses, which arrived from 1,435 entities. Multiple updates most frequently came from counties and places. Overall, the number of addresses sent by more than one participating LUCA entity was small.

5.10 How many entities submitted GQs and TLs?

Table 29 shows the number of entities that submitted address updates and Table 30 shows the entity submissions by type of living quarters.

Table 29. Number of Entities that Submitted Address Updates

	Count
Submitted Address Updates	**6,795**
Submitted HUs	6,650
Submitted GQs	2,167
Submitted TLs	72

Source: 2020 LUCA Production Control System and LUCA Master Table.

Table 30. Entity Submissions by Type of Living Quarters

	Count	Percent
Submitted Address Updates	6,795	
Submitted HUs only	4,481	65.9%
Submitted HUs and GQs (no TLs)	2,097	30.9%
Submitted HUs and TLs (no GQs)	4	0.1%
Submitted HUs and GQs and TLs	68	1.0%
GQs only	2	0.0%
GQs and TLs (no HUs)	0	0.0%
Submitted TLs only	0	0.0%
Submitted no Usable Updates	143	2.1%

Source: 2020 LUCA Production Control System and LUCA Master Table.

As shown in the tables above, 65.9 percent of entities submitted housing unit updates only and 30.9 percent submitted housing units and GQs without any TLs. Only 72 entities submitted address updates for TLs.

5.11 How many of the addresses were processed and what were the reasons addresses were not processed?

Table 31 shows a summary of LUCA addresses the Census Bureau processed and did not process along with the reasons that addresses were not processed.

Table 31. LUCA Address Summary

	Count	Percent
Addresses Received	**22,670,000**	
Addresses Processed	22,150,000	**97.7%**
Addresses Not Processed	519,000	**2.3%**
Add action duplicates with same address data but differing in other fields		48.1%
Exact record duplicate		32.9%
Records that contained “NO KNOWN ADDRESSES IN THIS BLOCK”		4.7%
Fails legal value check		2.0%
Record has invalid address data		2.5%
Unable to derive state, county, tract, block from lat/long		9.7%

Source: LUCA Master Table and 2020 LUCA Production Control System.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

The MAF validation process included a series of checks to ensure data quality of updates, including checks that resulted in “hard fails” that prevented some records from being loaded into the LUCA Master Table for subsequent processing. Of the addresses received from LUCA

entities, the Census Bureau successfully processed 97.7 percent and did not process 2.3 percent during preprocessing. Of the addresses that failed preprocessing checks, the highest number, or 48.1 percent, resulted from submissions that exactly matched other addresses but with some different data in other fields. Another 32.9 percent of addresses not processed were exact duplicates of another address. As a result, 81 percent of addresses not processed resulted from matches to other addresses.

During the 2010 LUCA operation, the Census Bureau received about 41,850,000 addresses, processed 99.6 percent of these addresses, and rejected 0.4 percent.

5.12 What are the results from LUCA addresses being matched to GSS, PEARSIS and MAF/TIGER?

Table 32 shows the results of LUCA address matching, including the number of addresses sent for matching, the number of unique addresses successfully matched and not matched, and the matches made by source category, including GSS, the MAF/TIGER database, and PEARSIS. Each source may have only covered a portion of addresses (for example, the GSS data only includes data from participating entities). However, reviews of the various address formats across each source helped the Census Bureau to determine the consistency of representation of LUCA addresses within these sources and to use the preponderance of the evidence from this matching process to help establish the probability of the existence of addresses and to remove address duplications.

Table 32. Results of LUCA Entity Addresses Matching

	Count	Percent of Addresses Sent to Matching
Total Addresses sent to Matching	**22,150,000**	**100.0%**
Unique Addresses Matched in the Matching Process	18,590,000	**83.9%**
Addresses Not Matched in any of the Matching Processes	3,559,000	**16.1%**
Matches by category*		
Total Addresses Matched in GSS Matching	4,796,000	21.7%
Total Addresses Matched in MTdb Matching	17,930,000	80.9%
Total Addresses Matched in PEARSIS Matching	10,010,000	45.2%

Source: LUCA Master Table.
*These categories are not mutually exclusive.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Of addresses sent for matching, 83.9 percent successfully matched to Census Bureau address sources and 16.1 percent did not match. Of the addresses matched, MAF/TIGER was responsible for 80.9 percent of matches, not exclusive of the other sources, making it the single most common matching source for the operation.

Table 33 shows address matching sources and match rates by category.

Table 33. LUCA Entity Addresses Matching: Unique Matched Addresses by Category

	Count	Percent of Matched Unique Addresses
Unique Addresses Matched in the Matching Process	**18,590,000**	**100.0%**
Total Addresses Matched in GSS Matching Only		3.1%
Total Addresses Matched in MTdb Matching Only		33.8%
Total Addresses Matched in PEARSIS Matching Only		0.3%
Addresses Matched in both GSS and MTdb but not PEARSIS		9.3%
Addresses Matched in both GSS and PEARSIS but not MTdb		0.1%
Addresses Matched in both MTdb and PEARSIS but not GSS		40.1%
Addresses Matched in GSS and MTdb and PEARSIS		13.3%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.

On its own, PEARSIS data did not necessarily provide a high match yield, but with validation in combination with MAF/TIGER it produced higher rates of matching.

5.13 What are the outcomes of the Entity Level Checks and how many entities and records failed Entity Level Checks?

Table 34 shows the number of LUCA submissions that passed and failed entity-level checks by number of checks.

Table 34. LUCA Entity Submissions that Failed Entity Level Checks

	Count	Percent
Submitted to the Entity Level Checks	**5,659**	
Passed all 32 Entity Level Checks	3,167	56.0%
Failed 1 to 5 Entity Level Checks	2,445	43.2%
Failed 6 to 10 Entity Level Checks	45	0.8%
Failed 11 to 15 Entity Level Checks	1	0.0%
Failed 16 or More Entity Level Checks	1	0.0%

Source: LUCA Entity-Level Check Table (on Devtran).
Numbers may not sum because of rounding.

These edits were implemented after the participating LUCA entities' submissions were matched against the GSS, MAF/TIGER, and PEARSIS. The entity level checks marked an entity's file with a status of "fail" based on the specific threshold for each edit. When a participating entity submission failed one or more of these edits, Geography Division subject matter experts received an email outlining the pass or fail status of each check. The subject matter experts reviewed the file and determined if failures could be overridden or fixed (e.g., bad MAFID). To

fix the errors, staff at the regional offices contacted the participating entity for clarification about the failures and if possible, resubmission of an updated file.

5.14 What are the results of LUCA Address Validation?

LUCA Address Validation prioritized work assignments based on the date the submission was received. As LUCA submissions were processed, the Matching and Coding Software (MaCS) system automatically assigned records into work units of 50 records, grouped by entity, to LUCA Address Validation reviewers. The LUCA Address Validation reviews used the address components, geocode, and matched MAF information, if it existed, of the LUCA participant address record to determine if the record was spatially accurate or if it already existed in the MAF. LUCA Address Validation reviewers made the determination whether to accept or reject the LUCA participant address record. If LUCA Address Validation reviewers determined that the record was nonresidential, uninhabitable, outside of the participants' jurisdiction, located in an undevelopable location, or did not exist, they rejected the record. The LUCA Address Validation reviewer had to have absolute and concrete evidence from a reliable source to reject an address record. If there was any ambiguity as to the existence of a record, the LUCA Address Validation reviewer accepted it.

The LUCA Address Validation QC process focused on reviewing the accuracy of individual records worked by LUCA Address Validation reviewers during production. The QC staff determined whether the action taken by the LUCA Address Validation reviewer was or was not a proper assessment of the LUCA participant's submission. Once all records completed the QC process within LUCA Address Validation, they were sent back to the main LUCA operation to complete the rest of the LUCA process.

Since the number of LUCA submissions was four times higher than expected[5], LUCA Address Validation implemented entity-level sampling to complete review for all LUCA participants on the schedule required for development of the 2020 Enumeration Universe. In files where 200 or more records were eligible for LUCA Address Validation, 20 percent of the entity's records were randomly selected and loaded in MaCS for review. Based on the LUCA Address Validation review of the 20 percent of the entity's records, if an entity passed the 80 percent threshold for acceptable actions, the remaining records were provisionally accepted. If the entity failed the 80 percent threshold, all remaining records were rejected. If an entity had fewer than 200 records, LUCA Address Validation reviewed all the records.

In total, more than 200 staff at NPC and headquarters reviewed 861,000 addresses sent to LUCA Address Validation by the LUCA operation. Table 35 provides a snapshot of reviewer actions during the LUCA Address Validation project. While addresses were rejected for being nonresidential or outside of the participants' jurisdiction, most were rejected because there was evidence that the address did not exist or could not exist in the location the participant

[5] The Census Bureau estimated LUCA participants would send about 5 million addresses. In 2020, LUCA participants submitted a total of more than 22 million addresses.

provided.[6] Overall, 61.3 percent of reviewed addresses were accepted (LUCA add or change record accepted) and 38.7 percent were rejected (LUCA Add or Change record rejected). Because LUCA Address Validation was a step in the LUCA operation, some of the end results on the MAF may vary based on how the MAF update process handled these cases. In other words, results from other preceding and subsequent processes could have affected the outcome of whether a LUCA participant's action code was accepted or rejected during the MAF update process.

Table 35. LUCA Address Validation Action Code Totals

	Code	Accept/ Reject	Number of Records	Percent of Accepted or Rejected	Percent of Total
Total Number of LUCA Address Validation Records			**861,000**		
Address Validated	A	Accept		59.8%	36.6%
Manual Match	L	Accept		6.7%	4.1%
Move	M	Accept		6.7%	4.1%
Provisional Add	P	Accept		26.9%	16.5%
	Total Accepted		**528,000**		61.3%
Address Rejected	R	Reject		76.8%	29.7%
Nonresidential	N	Reject		23.1%	8.9%
Outside of Jurisdiction	O	Reject		0.1%	0.0%
Uninhabitable	U	Reject		0.0%	0.0%
	Total Rejected		**333,000**		38.7%

Source: MaCS LUCA Address and LUCA Master Tables.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Table 36, Table 37, and Table 38 show LUCA Address Validation records by TEA and outcomes. In the breakdown by TEA, TEA 1 – Self Response had the largest number of LUCA Address Validation records, with 96.3 percent of all LUCA Address Validation records. In total, 300,000 records were validated in TEA 1 and added to the enumeration universe. An additional 137,000 records were provisionally added. LUCA Address Validation staff used the provisional add action code when they were unable to determine the existence of a housing unit on the ground and it was plausible for it to exist. In other words, LUCA Address Validation staff had evidence through local GIS sources, or there was ground clearing evident in imagery giving LUCA Address Validation reviewers the indication it could exist as a living quarter by Census Day, April 1, 2020.

[6] Again, LAV reviewers had to have absolute and concrete evidence from a reliable source to reject an address record. If there was any ambiguity as to the existence of a record, the LAV reviewer accepted it.

Table 36. Number of LUCA Address Validation Records Reviewed by TEA

	Total Records	Percent of Total
TEA 1 – Self Response		96.3%
TEA 2 – Update Enumerate		0.0%
TEA 4 – Remote Alaska		0.0%
TEA 6 – Update Leave		3.7%
Total for all TEAs*	**860,000**	100.0

Source: TEA values were derived from the MAF/TIGER BCU and TABBLOCK tables. LUCA Address Validation GEOIDs and results were derived from the MaCS LUCA Address and LUCA Master Tables.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.

Table 37. Number of LUCA Address Validation Records Reviewed in TEA 1 – Self Response

Description	Code	Accept/Reject	Number of Records	Percent of Accepted or Rejected	Percent of TEA 1
Total TEA 1 LUCA Address Validation Records			**827,000**		
Address Validated	A	Accept		59.4%	36.2%
Manual Match	L	Accept		6.7%	4.1%
Move	M	Accept		6.6%	4.0%
Provisional Add	P	Accept		27.2%	16.6%
	Total TEA 1 Accepted		**505,000**		**61.0%**
Address Rejected	R	Reject		76.7%	30.0%
Nonresidential	N	Reject		23.2%	9.0%
Outside of Jurisdiction	O	Reject		0.1%	0.0%
Uninhabitable	U	Reject		0.0%	0.0%
	Total TEA 1 Rejected		**323,000**		**39.0%**

Source: TEA values were derived from the MAF/TIGER BCU and TABBLOCK tables. LUCA Address Validation GEOIDs and results were derived from the MaCS LUCA Address and LUCA Master Tables.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

TEA 6 – Update Leave had the second largest number of LUCA Address Validation records, with 3.7 percent of the total. In total, LUCA Address Validation accepted 73.4 percent of the TEA-6 records worked. The remaining 26.6 percent were rejected. LUCA Address Validation contributed to the enumeration universe in Update Leave by validating 48.6 percent of records in TEA 6 and provisionally adding 14.9 percent of the TEA-6 records. The effect on the Update Leave operation may be similar to the one mentioned in the TEA 1 breakdown. BCUs in TEA 2 (Update Enumerate) and TEA 4 (Remote Alaska) were affected less by the LUCA Address Validation operation because, in total, only about 30 addresses were sent to LUCA Address Validation in these TEAs.

Table 38. Number of LUCA Address Validation Records Reviewed in TEA 6 – Update Leave

Description	Code	Accept/ Reject	Number of Records	Percent of Accepted or Rejected	Percent of TEA 6
Total TEA 6 LUCA Address Validation Records			**32,000**		
Address Validated	A	Accept		66.2%	48.6%
Manual Match	L	Accept		4.8%	3.5%
Move	M	Accept		8.8%	6.4%
Provisional Add	P	Accept		20.3%	14.9%
	Total TEA 6 Accepted		**23,500**		**73.4%**
Address Rejected	R	Reject		80.2%	21.3%
Nonresidential	N	Reject		19.7%	5.2%
Outside of Jurisdiction	O	Reject		0.1%	0.0%
Uninhabitable	U	Reject		0.0%	0.0%
	Total TEA 6 Rejected		**8,500**		**26.6%**

Source: TEA values were derived from the MAF/TIGER BCU and TABBLOCK tables. LUCA Address Validation GEOIDs and results were derived from the MaCS LUCA Address and LUCA Master Tables.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

5.15 What are the results of MAF updating for Add actions?

Table 39 shows the breakdown of LUCA Add actions processed by outcome. See Table 4 for explanations of all actions that entities could take on the address list. The adds below reflect the accepted Add actions from the LUCA operation. Provisional adds were Add actions accepted by the Census Bureau in cases where evidence did not conclusively prove an address did or did not exist. The Census Bureau considered these to be low-confidence records.

Table 39. Outcomes of MAF/TIGER Update

	Not Provisional	Percent of Not Provisional Adds	Provisional	Percent of Provisional Adds	Total Adds	Percent of Adds
Total Adds					**10,670,000**	**100.0%**
Rejected Adds					**1,204,000**	**11.3%**
Accepted Adds	**5,780,000**	61.1%	**3,684,000**	38.9%	**9,464,000**	**88.7%**
Matched to an existing residential address record in MTdb in the enumeration universe		57.1%		5.7%		62.8%
Created new address record since there was no match in the MTdb (true adds)		3.6%		31.8%		35.4%
Matched to nonresidential units / later changed to housing units in the MTdb*		0.3%		1.5%		1.8%
Matched to an existing address record in MTdb NOT in the enumeration universe		<0.1%		<0.1%		<0.1%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
*Not Provisional adds all were sent for enumeration; 92.3 percent of Provisional adds in this category went on to enumeration.
This table includes data for all MAF Adds, including cases where two or more source address records were used to update one Updated MAF record.

Adds by entities that matched to an existing MAF address made up 62.8 percent of the Add actions that the Census Bureau processed, while “true” adds made up 35.4 percent. Provisional adds made up 38.9 percent of all the LUCA adds.

During the 2010 LUCA operation, the Census Bureau received actions for Options 2 and 3 participants as adds because participants submitted their complete address lists. Across all the options, the 2010 LUCA operation processed 9,314,969 new adds, merged 24,576,735 records with existing active MAF records, and merged 4,499,926 records with existing ungeocoded MAF records. For Option 1 (which is most comparable to the 2020 operation because these participants could submit updates), LUCA processed a total of 4,136,066 new adds, merged 2,344,689 records with existing active MAF records, and merged 2,546,452 records with existing ungeocoded MAF records.

5.16 What are the results of MAF updating for Change actions?

Table 40 shows the total number of LUCA Change actions the Census Bureau processed.

Table 40. Summary of LUCA Change Actions

	Count Accepted	Percent of Rejected "C" Actions for Geocoding Changes	Count Rejected	Percent of Rejected "C" Actions for Geocoding Changes	Total	Percent of Total "C" Action Codes for Geocoding Changes
Total Change Actions	**6,009,000**					
"C" Action Code for Geocoding Changes	**580,000**	**100.0%**	**374,000**	**100.0%**	**954,000**	100.0%
Geocoding changes that were accepted in the location the partner provided		93.5%		9.4%		60.5%
Geocoding changes that were moved to a new location		6.5%		90.6%		39.5%
Geocoding changes that were kept in the original census location*		5.8%		88.4%		38.2%
Other Changes	**5,429,000**					

*Category not mutually exclusive of changes accepted in the partner location or the changes moved to a new location.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
Source: LUCA Master Table.

The Census Bureau processed 6,009,000 Change actions from LUCA participants. For comparison, the 2010 LUCA operation included 2,235,352 Change actions for Option 1 participants.

Of the accepted 2020 Change actions, 580,000 records consisted of geocoding changes. Other changes, typically changes to address components, made up the other 5,429,000 records. Of the geocoding changes, the Census Bureau accepted 93.5 percent of records in the block provided by the LUCA entity and moved 6.5 percent of records to a different block. The other geocoding changes did not result in a location move. Most of these cases resulted from matches to MAF records with a different geocode than the one submitted by an entity.

5.17 What are the results of MAF updating for Delete, Out of Jurisdiction, and Nonresidential actions?

Table 41 shows the number of negative (Delete, Out of Jurisdiction, and Nonresidential) actions submitted from the participating entities and their status.

Table 41. Processed LUCA Negative Actions

	Percent of Total	Count	Percent of Action
Total		**4,359,000**	
Total Delete Actions	**73.6%**	**3,207,000**	
Delete Actions Accepted			57.3%
Delete Actions Rejected			42.7%
Total Out of Jurisdiction Actions	**25.4%**	**1,106,000**	
Out of Jurisdiction Actions Accepted			0.0%
Out of Jurisdiction Actions Rejected			100%
Total Nonresidential Actions	**1.0%**	**45,500**	
Nonresidential Actions Accepted			97.1%
Nonresidential Actions Rejected			2.9%

Source: 2020 LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Deletes made up 73.6 percent of the negative actions submitted by LUCA entities, followed by Out of Jurisdiction actions at 25.4 percent. Most of the rejected Delete actions occurred as a result of the multiple update hierarchy rules, which meant that another version of the address was successfully updated. The second most common reason for rejected Delete actions was illegal/missing values in the record. The Census Bureau rejected all of the Out of Jurisdiction actions because of misunderstandings about the meaning of this action. For example, a county may have marked addresses from an entire subentity, like a city, as Out of Jurisdiction, which would have resulted in deletion of those addresses. Nonresidential actions made up just 1.0 percent of the negative actions from LUCA entities. Of these, the Census Bureau accepted 97.1 percent and rejected 2.9 percent. The rejected negative action records remained in the MAF as living quarters and moved on to enumeration.

For general comparison, Option 1 entities during the 2010 LUCA operation submitted 628,359 Delete actions, 398,359 Out of Jurisdiction actions, and 32,542 Nonresidential actions. The options offered to 2010 LUCA entities restricted the number of Delete actions that entities could take (for example, the adds-only option), and the 2020 Delete actions were often found in combination with Adds actions, indicating entity attempts to make changes to these records using these combinations, rather than using Change actions.

5.18 How many ungeocoded address records sent to state and county governments were returned with geocodes?

The USPS provides mailable addresses, to which they can deliver, to the Census Bureau on a regular basis in the DSF. These addresses include Zone Improvement Plan (ZIP) Codes as well as state and county codes that are meaningful for USPS operations. After receipt, the Census Bureau attempts to geocode these addresses to a census tract and census block.

Geocoding is first attempted using automated processes that use address data within the MAF/TIGER System to determine the appropriate tract and block geocodes by either matching the new address to a geocoded address in the MAF/TIGER System or by matching it to an address range in TIGER. These automated processes are not always able to assign census block codes to all addresses. Some reasons for this include:

- The street feature was not in TIGER or the name was incorrect.
- The street feature was missing all or part of the address range in TIGER or the range was incorrect.
- All or part of the street feature information (e.g., street name spelling, ZIP Code) in TIGER was inconsistent with how the address was represented on the MAF.
- The address was in MAF/TIGER but the difference between the MAF/TIGER address and the DSF address did not allow the automated process to match it.

When automated geocoding processes are unable to assign a geocode, these addresses remain ungeocoded and not eligible for inclusion in the 2020 Census (Richmond and Hanks, 2022).

Table 42 shows the number of ungeocoded records sent for review that entities updated in their submissions.

Table 42. Ungeocoded Records Sent to Governments and Returned Addresses with Geocodes

	Count	Percent
Ungeocoded addresses sent to governments	680,000	
Number of ungeocoded addresses that came back with geocodes	592,000	87.0%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.

Because ungeocoded addresses included state and county information, the Census Bureau decided to provide the ungeocoded addresses to the state and county LUCA partners. Providing the ungeocoded addresses allowed the entities to simply provide a geocode to an address that they normally would have had to identify as missing and then add as new, which is a more complex process. This allowed those LUCA partners to focus on areas of concern, such as areas of new growth where the Census Bureau may be missing roads. Of the ungeocoded records sent to entities for update, 87.0 percent received geocodes from participating entities.

5.19 How many LUCA entities submitted spatial updates and how were they processed?

The Census Bureau processes spatial updates either by digitizing or conflation. Digitizing refers to the manual addition of spatial data into the MAF/TIGER database using the GATRES system. Census Bureau staff use spatial data and satellite imagery to manually add, remove, or modify

individual features in the MAF/TIGER database. Conflation is an automated change detection and batch update process. The Census Bureau evaluated spatial data submitted by partners against the MAF/TIGER database using both 1Spatial and Esri software. The Census Bureau then applied accepted change detection proposals directly to the database using the software. Roads were the only feature type that the Census Bureau updated during these processes.
Table 43 shows the number of spatial updates submitted by participating LUCA entities and the methods used to make the updates to MAF/TIGER.

Table 43. Spatial Updates Submitted by LUCA Entities and Methods of Update

	Count	Percent
Entities that submitted spatial updates	2,261	
Paper spatial updates digitized*	445	19.7%
Paper spatial updates not requiring digitizing**	500	22.1%
Digital spatial updates digitized	719	31.8%
Digital spatial updates conflated*	598	26.4%

Source: 2020 LUCA Production Control System.
*The subcategories do not add up to 2,261 as one entity submitted both paper and digital formats and both were processed. Paper updates were digitized (included in the 445) and the digital updates completed through conflation (included in the 598).
**These updates were largely because of people returning their large format materials, which NPS logged that part of the submission in the PCS but at the time of processing, the NPC processor realized there were no feature updates to be made. Or, in other cases, the entity ended up using the large format map for some other purpose, such as adding mapspots that cross walked to their addresses but did not use the maps for feature updates. As a result, these updates did not require digitizing.

Table 44 shows the summary of spatial updates made as part of the LUCA program.

Table 44. Summary of LUCA Spatial Updates

	Count
Features added	29,777
Total miles of features added	5,877
Existing features modified*	15,359

Source: 2020 LUCA Production Control System and MAF/TIGER Database.
*If a different operation modified a feature after LUCA, that modified feature received a different source code and therefore cannot be included in this table because MAF/TIGER only retains source information for the last operation to make an update.

Of the entities that submitted spatial updates, the Census Bureau digitized 53.9 percent of the updates (both digital and paper submissions) and conflated 26.4 percent of updates (digital submissions). In total, 15,359 existing features were modified and 29,777 new features were added to the MTdb.

5.20 How many total GQs and TLs were processed?

Table 45 shows the accepted/rejected MAF update status of LUCA addresses by living quarters type.

Table 45. Accepted and Rejected Status of LUCA Addresses for MAF Update

	Total*	Percent of Processed Addresses	Accepted	Rejected
Processed Addresses	**22,150,000**			
			99.6%	0.4%
HUs	22,050,000	99.6%		
			99.8%	0.2%
GQs	95,000	0.4%		
			54.0%	46.0%
TLs	3,300	0.0%		
			78.7%	21.3%

*Total shown represents all records successfully loaded to the LMT prior to any MAF update.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.
Source: 2020 LUCA Production Control System and LUCA Master Table.

Of addresses submitted to the LUCA program, the Census Bureau accepted 99.6 percent for MAF update. Of the GQs, the Census Bureau accepted 54.0 percent and rejected 46.0 percent. The majority of the rejected GQ records were rejected because they matched an existing residential record.

5.21 How many entities received feedback, opted out of receiving LUCA feedback, and were ineligible to receive feedback?

Table 46 shows the summary of LUCA feedback provided to entities by the Census Bureau.

Table 46. LUCA Feedback Status

	Count	Percent
Entities Registered for LUCA	**11,549**	
Entities Sent LUCA Feedback	6,954	60.2%
Entities Not Sent LUCA Feedback	4,595	39.8%
Opted out of LUCA Feedback	1,296	28.2%
Ineligible to Receive LUCA Feedback	3,299	71.8%

Source: 2020 LUCA Production Control System.

Of the 4,595 entities that did not receive LUCA feedback, 71.8 percent were ineligible to receive feedback while 28.2 percent opted out of receiving LUCA feedback. There were a variety of reasons why 3,299 entities were ineligible to receive LUCA feedback including providing responses too late to receive feedback, sending along only their Destruction of Materials forms,

and submitting a form indicating a return with no updates or changes and neglecting to check the box marked “Yes, I want feedback,” therefore failing to enter the LUCA feedback universe.

Table 47 shows a summary of LUCA feedback provided by the Census Bureau by the entity’s number of addresses.

Table 47. LUCA Feedback Status by Entity Size

	Entities Registered for LUCA	Percent of Registered Entities	Sent LUCA Feedback	Opted out of LUCA Feedback	Ineligible to Receive LUCA Feedback
Total	**11,549**		6,954	1,296	3,299
			60.2%	11.2%	28.6%
1,000 or Fewer Addresses	4,277	37.0%	2,126	685	1,466
			49.7%	16.0%	34.3%
1,001 – 6,000 Addresses	3,616	31.3%	2,048	409	1,159
			56.6%	11.3%	32.1%
6,001 – 50,000 Addresses	2,994	25.9%	2,202	174	618
			73.5%	5.8%	20.6%
50,001 – 100,000 Addresses	316	2.7%	275	9	32
			87.0%	2.8%	10.1%
100,001 – 1,000,000 Addresses	305	2.6%	265	18	22
			86.9%	5.9%	7.2%
1,000,001 or More Addresses	41	0.4%	38	1	2
			92.7%	2.4%	4.9%

Source: 2020 LUCA Production Control System.

The Census Bureau provided LUCA feedback to 60.2 percent of the 11,549 registered entities for LUCA, while 28.6 percent of entities were ineligible to receive LUCA Feedback. Relatively more large entities received feedback than smaller entities and smaller entities were more often ineligible to receive feedback.

Table 48 shows LUCA feedback status based on entity type.

Table 48. LUCA Feedback Status by Entity Type

	Entities Registered for LUCA	Percent of Registered Entities	Entities Received LUCA Feedback	Entities Opted out of LUCA Feedback	Entities ineligible to receive LUCA Feedback
Total	**11,549**		6,954	1,296	3,299
			60.2%	11.2%	28.6%
AIA	146	1.3%	84	6	56
			57.5%	4.1%	38.4%
ST	47	0.4%	41	2	4
			87.2%	4.3%	8.5%
CO	1,866	16.2%	1,331	130	405
			71.3%	7.0%	21.7%
MCD	2,198	19.0%	1,115	395	688
			50.7%	18.0%	31.3%
PL	7,292	63.1%	4,383	763	2,146
			60.1%	10.5%	29.4%

Source: 2020 LUCA Production Control System.

The Census Bureau sent feedback to 87.2 percent of states and 71.3 percent of counties. These entities were also least likely to be ineligible to receive LUCA feedback. Minor civil divisions most frequently opted out of receiving feedback.

5.22 How many LUCA addresses were assigned a feedback code and which codes did they receive?

Table 49 shows a summary of LUCA feedback codes (Table 5 shows a full description of the LUCA feedback codes). Table 50 shows all LUCA addresses for which the Census Bureau assigned feedback codes compared with other entity types.

Table 49. Summary of LUCA Feedback Codes

Feedback Code	Eligible Participant Actions	Description
A01	A, C	**Address is in the 2020 Census in the same block.** The Census Bureau included this address in the 2020 Census for your jurisdiction in the same block and accepts your LUCA update.
A02	A, C	**Address is in the 2020 Census in a different block.** The Census Bureau included this address in the 2020 Census for your jurisdiction in a different block and accepts your LUCA update.
A03	D, J, N	**Address is not in the 2020 Census.** The Census Bureau excluded this address from the 2020 Census for your jurisdiction and accepts your LUCA update.
R01	A, D, J, N	**Address is in the 2020 Census in the same block.** The Census Bureau included this address in the 2020 Census for your jurisdiction in the same block and rejects your LUCA update.
R02	D, J, N	**Address is in the 2020 Census in a different block.** The Census Bureau included this address in the 2020 Census for your jurisdiction in a different block and rejects your LUCA update.

R03	A, C	**Address is not in the 2020 Census.** The Census Bureau excluded this address from the 2020 Census for your jurisdiction and rejects your LUCA update.
X01	A, C, D, J, N	**Address removed from the 2020 Census.** The Census Bureau excluded this address from the 2020 Census for your jurisdiction because this address has been deleted from the 2020 Census Address list by a different census operation or another level of government participating in LUCA.

Source: 2020 Census Local Update of Census Addresses Operation (LUCA) Feedback and Appeals Respondent Guide.

Table 50. LUCA Addresses Assigned to Feedback Codes

	Total	Percent	Feedback Codes						
			A01	A02	A03	R01	R02	R03	X01
Total, All Codes	23,660,000		69.4%	3.2%	4.7%	13.1%	0.6%	2.6%	6.4%
A	10,670,000	45.1%	91.0%	3.3%	NA	0.1%	NA	5.6%	0.0%
C	7,131,000	30.1%	94.0%	5.7%	NA	NA	NA	0.2%	0.1%
D	4,399,000	18.6%	NA	NA	24.0%	46.2%	2.7%	NA	27.1%
J	1,118,000	4.7%	NA	NA	2.6%	93.3%	3.1%	NA	1.0%
N	76,000	0.3%	NA	NA	32.2%	26.2%	1.2%	NA	40.4%
No Action Code	264,000	1.1%	NA	NA	NA	NA	NA	NA	100.0%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Of the 23,660,000 addresses assigned to feedback codes, 69.4 percent received a feedback code of A01, indicating the Census Bureau accepted the record from the entity and the location matched the Census Bureau's location. Of addresses with an Add action code, 91.0 percent received an A01 feedback code, as did 94.0 percent of addresses with a Change action code. Adds made up 45.1 percent of the addresses that were assigned a feedback code.

X01 records were provided to entities participating in LUCA Feedback if the record was deleted by another entity participating in LUCA or another census operation. For example, if a state and place-level government both participated in LUCA and the state-level government deleted a record falling within the jurisdictional boundary of the place, the place would have received that record on their LUCA Feedback address list as an X01 record. This is a reason that there are more action codes reported than addresses. The place then had the opportunity to appeal the deletion of the record. Additionally, had another census operation deleted a record falling with the jurisdictional boundary of the state and place-level government, both would have received that address on their LUCA Feedback address list. The X01 records were stored in a separate table from the LUCA Master Table.

The No Action Code units shown above did not have an action code from LUCA but because a negative action occurred, they received an X01 code and were sent as part of feedback to those participants to let them know that a negative action was taken on the record from a different operation or LUCA entity.

Table 51 shows feedback codes for living quarters by entity type.

Table 51. LUCA Addresses Assigned a Feedback Code for Each Entity Type

	Total	Percent	AIA	ST	CO	MCD	PL
Total, All Feedback Codes	**23,660,000**		0.2%	17.2%	47.8%	1.9%	32.9%
HUs	23,550,000	99.5%	0.2%	17.1%	48.0%	1.9%	32.9%
GQs	104,000	0.4%	<0.1%	49.7%	22.1%	1.7%	26.4%
TLs	3,300	<0.1%	0.0%	18.1%	6.7%	0.2%	75.0%
A01	16,420,000	69.4%	0.1%	15.9%	45.1%	1.9%	36.9%
A02	751,000	3.2%	<0.1%	32.8%	53.0%	0.9%	13.2%
A03	1,111,000	4.7%	0.7%	5.6%	60.4%	3.5%	29.8%
R01	3,103,000	13.1%	0.1%	3.5%	69.8%	1.5%	2.15%
R02	153,000	0.6%	0.1%	2.0%	53.6%	1.9%	42.3%
R03	614,000	2.6%	0.2%	14.2%	34.6%	1.3%	49.7%
X01	1,508,000	6.4%	0.2%	63.9%	25.1%	1.6%	9.3%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Appendix B includes details about HUs, GQs, and TLs. Table 81 shows details about feedback codes for housing units by entity type, Table 82 shows details about feedback codes for GQs by entity type, and Table 83 shows details about feedback codes for TLs by entity type.

Housing units made up 99.5 percent of living quarters that received feedback codes. Counties received 47.8 percent of feedback codes, followed by places at 32.9 percent. Of the 1,508,218 addresses assigned an X01 code, 63.9 percent were provided to a state-level entity. This outcome would be expected in cases where lower-level entities acted on records and the state-level entity did not.

A01 feedback codes made up 69.5 percent of all housing unit feedback codes. Of the addresses assigned a feedback code of A01, 45.1 percent went to addresses within county submissions, while 36.9 percent went to addresses with place submissions. X01 codes made up 6.4 percent of the addresses with feedback codes.

Of the 23,660,000 address records that received LUCA feedback codes, 0.4 percent were GQ records. Of these, 50.4 percent had an “accepted update from entity” feedback code, while 40.6 percent had a “rejected update from entity” feedback code.

Of the addresses assigned LUCA feedback codes, less than 0.1 percent were TLs. Of these, 81.0 percent had an “accepted update from entity” feedback code and 19.0 percent had a “rejected update from entity” feedback code.

Table 52 shows details about the feedback code A01 by action code and entity type.

Table 52. LUCA Addresses Assigned Feedback Code A01

	Total	Percent	AIA	ST	CO	MCD	PL
Code A01	**16,420,000**						
			0.2%	15.9%	45.1%	1.9%	36.9%
A action code	9,712,000	59.2%					
			0.2%	17.5%	43.1%	1.7%	37.5%
C action code	6,706,000	40.8%					
			0.1%	13.5%	48.1%	2.2%	36.2%
D action code	NA		NA	NA	NA	NA	NA
N action code	NA		NA	NA	NA	NA	NA
J action code	NA		NA	NA	NA	NA	NA

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

The Census Bureau assigned feedback code A01 only to Add and Change actions from participants. This code indicated that the address moved forward in the 2020 Census enumeration process within the block the entity provided because it matched the census block. Of addresses assigned an A01 feedback code, 59.2 percent were Add actions and 40.8 percent were Change actions.

Table 53 shows details about the feedback code A02 by action code and entity type.

Table 53. LUCA Addresses Assigned Feedback Code A02

	Total	Percent	AIA	ST	CO	MCD	PL
Code A02	**751,000**						
			0.0%	32.8%	53.0%	0.9%	13.2%
A action code	348,000	46.3%					
			0.1%	47.6%	35.2%	1.4%	15.7%
C action code	403,000	53.7%					
			<0.1%	20.1%	68.4%	0.4%	11.1%
D action code	NA		NA	NA	NA	NA	NA
N action code	NA		NA	NA	NA	NA	NA
J action code	NA		NA	NA	NA	NA	NA

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

The Census Bureau assigned feedback code A02 only to Add and Change actions from participants. This code indicated that the address moved forward in the 2020 Census enumeration process in a different block than the one provided by the entity. Of addresses assigned an A02 feedback code, 49.3 percent were Add actions and 53.7 percent were Change actions.

Table 54 shows details about the feedback code A03 by action code and entity type.

Table 54. LUCA Addresses Assigned Feedback Code A03

	Total	Percent	AIA	ST	CO	MCD	PL
Code A03	**1,111,000**						
			0.7%	5.6%	60.4%	3.5%	29.8%
A action code	NA		NA	NA	NA	NA	NA
C action code	NA		NA	NA	NA	NA	NA
D action code	1,058,000	95.2%					
			0.7%	5.8%	60.3%	3.4%	29.8%
N action code	24,500	2.2%					
			1.1%	0.4%	49.0%	10.1%	39.4%
J action code	29,000	2.6%					
			0.3%	2.5%	71.9%	2.6%	22.7%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

The Census Bureau assigned feedback code A03 only to Delete, Nonresidential, and Out of Jurisdiction actions from participants. This code indicated that the address did not move forward to the 2020 Census enumeration process. Of addresses assigned an A03 feedback code,

95.2 percent were Delete actions, 2.6 percent were Out of Jurisdiction actions, and 2.2 percent were Nonresidential actions.

Table 55 shows details about the feedback code R01 by action code and entity type.

Table 55. LUCA Addresses Assigned Feedback Code R01

	Total	Percent	AIA	ST	CO	MCD	PL
Code R01	**3,103,000**						
			0.1%	3.5%	69.8%	1.5%	25.1%
A action code	8,000	0.3%					
			0.0%	45.5%	8.8%	0.1%	45.6%
C action code	NA		NA	NA	NA	NA	NA
D action code	2,033,000	65.5%					
			0.2%	4.3%	56.8%	1.8%	36.9%
N action code	20,000	0.6%					
			0.2%	0.2%	65.4%	4.8%	29.5%
J action code	1,043,000	33.6%					
			<0.1%	1.5%	95.7%	0.9%	1.9%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

The Census Bureau assigned feedback code R01 only to Add, Delete, Nonresidential, and Out of Jurisdiction actions from participants. This code indicated that the address moved forward to the 2020 Census enumeration process. Of addresses assigned an R01 feedback code, 65.5 percent were Delete actions, 33.6 percent were Out of Jurisdiction actions, 0.6 percent were Nonresidential actions, and 0.3 percent were Add actions.

Table 56 shows details about the feedback code R02 by action code and entity type.

Table 56. LUCA Addresses Assigned Feedback Code R02

	Total	Percent	AIA	ST	CO	MCD	PL
Code R02	**153,000**						
			0.1%	2.0%	53.6%	1.9%	42.3%
A action code	NA		NA	NA	NA	NA	NA
C action code	NA		NA	NA	NA	NA	NA
D action code	117,000	76.7%					
			0.1%	1.9%	43.4%	2.2%	52.4%
N action code	900	0.6%					
			0.7%	0.5%	62.9%	3.5%	32.4%
J action code	34,500	22.7%					
			0.1%	2.5%	87.8%	0.9%	8.7%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

The Census Bureau assigned feedback code R02 only to Delete, Nonresidential, and Out of Jurisdiction actions from participants. This code indicated that the address moved forward to the 2020 Census enumeration process. Of addresses assigned an R02 feedback code, 76.7 percent were Delete actions, 22.7 percent were Out of Jurisdiction actions, and 0.6 percent were Nonresidential actions.

Table 57 shows details about the feedback code R03 by action code and entity type.

Table 57. LUCA Addresses Assigned Feedback Code R03

	Total	Percent	AIA	ST	CO	MCD	PL
Code R03	**614,000**						
			0.2%	14.2%	34.6%	1.3%	49.7%
A action code	600,000	97.7%					
			<0.1%	13.3%	34.6%	1.4%	50.7%
C action code	14,000	2.3%					
			0.8%	54.7%	34.6%	0.7%	9.2%
D action code	NA		NA	NA	NA	NA	NA
N action code	NA		NA	NA	NA	NA	NA
J action code	NA		NA	NA	NA	NA	NA

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

The Census Bureau assigned feedback code R03 only to Add and Change actions from participants. This code indicated that the address did not move forward to the 2020 Census enumeration process. Of addresses assigned an R03 feedback code, 97.7 percent were Add actions and 2.3 percent were Change actions. These represent addresses rejected for update by the Census Bureau for a variety of reasons, for example because Census Bureau considered these duplicates of addresses already in the MAF.

5.23 What were the enumeration results for LUCA addresses?

The Census Bureau uses filters to select addresses for operations. Filters include rules about which addresses to include. For example, the Census Bureau may include ungeocoded addresses for reviews of addresses, but ungeocoded addresses would not be included in the enumeration filter to enumerate addresses. For this reason, only 16,440,000 records of the 22,150,000 records processed from the LUCA operation went on to be included in downstream enumeration operations.

The Census Bureau also distinguishes between “matched” adds to the MAF from “true adds,” in which the adds do not, based on matching rules, match to existing MAF records and so receive new MAFIDs. In some cases, addresses had slightly different address components and locations

(such as an adjacent block), so could be considered a true add but also later match to an existing MAFID. True adds could also fail the enumeration filter (for example, if another operation removed the address or the address eventually matched to another record).

Table 58 shows LUCA addresses that were enumerated or received a positive action. The Census Bureau enumerated 79.0 percent of LUCA addresses sent for enumeration. Of the addresses not enumerated, 94.1 percent were found not valid for the 2020 Census.

After the 2010 LUCA operation, the Census Bureau enumerated 28,715,743 LUCA addresses; found 3,392,016 LUCA addresses vacant; deleted 56,666 addresses; and found 11,003 addresses Nonresidential. Of the 32,175,428 addresses that moved on to enumeration from the 2010 LUCA operation, the Census Bureau enumerated 99.8 percent and found 10.6 percent of the enumerated addresses vacant.

The Census Bureau enumerated 37.6 percent of the LUCA true adds sent for enumeration in 2020. The Census Bureau enumerated 36.3 percent of LUCA true adds not included on the DSF and 49.1 percent of provisional adds.

Table 58. LUCA Addresses Enumerated or Received a Positive Action

	All LUCA Records	% Of LUCA Addresses in Extract	Reviewed by LAV*	% Of LUCA Addresses in Extract	True Adds	% Of LUCA Addresses in Extract	Provisional Adds	% Of LUCA Addresses in Extract	True Adds not on DSF**	% Of LUCA Addresses in Extract
Total LUCA Addresses Included in the Enumeration Extract	**16,440,000**	**100.0%**	**727,000**	**4.4%**	**3,217,000**	**19.6%**	**3,572,000**	**21.7%**	**3,143,000**	**19.1%**
LUCA Addresses Enumerated	12,990,000	**79.0%**	512,000	**3.1%**	1,209,000	**7.4%**	1,753,000	**10.7%**	1,141,000	**6.9%**
Occupied	11,430,000	**69.5%**	432,000	**2.6%**	888,000	**5.4%**	1,401,000	**8.5%**	827,000	**5.0%**
Vacant	1,555,000	9.5%	79,500	0.5%	321,000	2.0%	352,000	2.1%	314,000	1.9%
LUCA Addresses Not Enumerated	3,453,000	**21.0%**	215,000	**1.3%**	2,009,000	**12.2%**	1,819,000	11.1%	2,002,000	**12.2%**
HU Not in 2020 Census	3,249,000	19.8%	206,000	1.3%	1,862,000	11.3%	1,754,000	10.7%	1,856,000	11.3%
Vacant GQ	3,200	0.0%	200	0.0%	1,800	0.0%	800	0.0%	1,800	0.0%
Nonexistent GQ	2,800	0.0%	150	0.0%	1,800	0.0%	1,200	0.0%	1,800	0.0%
Duplicate GQ	100	0.0%	<15	0.0%	60	0.0%	30	0.0%	60	0.0%
Nonresidential GQ	50	0.0%	<15	0.0%	<15	0.0%	<15	0.0%	<15	0.0%
Retired Duplicate	197,000	1.2%	8,400	0.1%	143,000	0.9%	63,000	0.4%	143,000	0.9%

Source: LUCA Master Table, CenStat 2020 data.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
Notes: Found by taking the count of records with MAFSRC 205 or 206 - the count of records with MAFSRC 205 AND 206 that were in the enumeration universe based on censtat2020. Vacant is the count of censtat2020 = 1,2 where popdec2020 = 0 (a subset of enumerated). LUCA ADDS were derived by looking at records where MAFSRC 205/206 existed on the pdmafx (the original source code for a record) as opposed to the pdmafop (historical source code information). This table includes data representing final updated MAF records after multiple source entity hierarchy rules applied a single update to each record.
*Reviewed by LUCA Address Validation (LAV) calculated using TAB20 PDMAFOP, MAFX, MAFUNIT.
**LUCA ADDS Not on the DSF = without a residential flag on DSFSPR19, DSFFAL19, or DSFSPR20
LUCA Address Validation eligible records consisted of “new add” records that did not match to the MAF and/or were not located in Block Tracking Database active blocks as well as block moves or adds that matched to existing MAFUNIT in a different block. In contrast, records that did not go to LUCA Address Validation either matched to an existing MAFUNIT, rejected in preprocessing check, or were resolved through the automated validation software. When comparing enumeration results between both universes of records, the quality of the data should also be considered.

As discussed above in Section 5.15, provisional adds were addresses for which evidence could not prove or disprove existence at the time of LUCA. Enumeration status of these records is interesting because the Census Bureau did not previously have information about the quality and reliability of these records. The Census Bureau enumerated 49.1 percent of LUCA provisional adds and the other 50.9 percent were not enumerated.

Table 59 shows LUCA address enumeration results by record match combinations, and Table 60 shows enumeration results for LUCA true adds by record match combinations. Overall, enumeration rates for records matched to multiple sources exceeded enumeration rates for records matched to single sources in the LUCA universe. This pattern does not hold for true adds, which showed lower enumeration rates than the total universe of LUCA records.

Table 59. LUCA Addresses Enumeration Results for Match Combinations to MTdb, GSS, and PEARSIS

	LUCA Addresses Sent to Enumeration	LUCA Addresses Enumerated	LUCA Addresses not Enumerated
Total	**16,440,000**		
		79.0%	**21.0%**
Matched to GSS	3,607,000		
		75.8%	24.2%
Matched to MTdb	13,020,000		
		87.2%	12.8%
Matched to PEARSIS	7,537,000		
		93.6%	6.4%
Matched to GSS Only	511,000		
		34.9%	65.1%
Matched to MTdb Only	4,691,000		
		82.5%	17.5%
Matched to PEARSIS Only	46,000		
		66.6%	33.4%
Matched by GSS and MTdb but not PEARSIS	1,357,000		
		70.5%	29.5%
Matched by GSS and PEARSIS but not MTdb	22,500		
		65.3%	34.7%
Matched by MTdb and PEARSIS but not GSS	5,777,000		
		94.3%	5.7%
Matched by GSS and MTdb and PEARSIS	1,739,000		
		92.2%	7.8%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Table 60. LUCA True Adds Enumeration Results for Match Combinations to MTdb, GSS, and PEARSIS

	LUCA True Adds Sent to Enumeration	LUCA True Adds Enumerated	LUCA True Adds not Enumerated
Total	**3,217,000**		
		37.6%	**62.4%**
Matched to GSS	540,000		
		30.5%	69.5%
Matched to MTdb	581,000		
		46.7%	53.3%
Matched to PEARSIS	166,000		
		56.7%	43.3%
Matched to GSS Only	440,000		
		26.4%	73.6%
Matched to MTdb Only	393,000		
		43.8%	56.2%
Matched to PEARSIS Only	31,000		
		54.9%	45.1%
Matched by GSS and MTdb but not PEARSIS	68,000		
		45.2%	54.8%
Matched by GSS and PEARSIS but not MTdb	14,500		
		58.3%	41.7%
Matched by MTdb and PEARSIS but not GSS	103,000		
		57.3%	42.7%
Matched by GSS and MTdb and PEARSIS	17,500		
		55.0%	45.0%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Table 61 shows LUCA enumeration results for HUs, GQs, and TLs. Table 62 shows enumeration results for LUCA true adds for HUs, GQs, and TLs. The Census Bureau enumerated LUCA housing units at a rate of 79.1 percent, followed by GQs at 49.8 percent, and TLs at 16.0 percent. Of

LUCA true adds, the Census Bureau enumerated housing units at a rate of 37.6 percent, followed by GQs at 40.1 percent and TLs at 13.2 percent.

Table 61. LUCA Addresses Enumeration Results for HUs, GQs, and TLs

	LUCA Addresses Sent to Enumeration	Percent of Addresses Sent for Enumeration	LUCA Addresses Enumerated	LUCA Addresses found as vacant (Subset of Enumerated)	LUCA Addresses Not in 2020 Census
Total	**16,440,000**		**79.0%**	**12.0%**	**21.0%**
HUs	16,390,000	99.7%	79.1%	12.0%	20.9%
GQs	34,000	0.2%	49.8%	1.8%	50.2%
TLs	14,000	0.1%	16.0%	84.0%	84.0%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
*Enumeration status for TLs was based on TLs with a LUCA source (ENUMUNV = T). While ENUMUNV = T records were initially flagged as TLs, census enumeration operations found some to be GQs, HUs, or even transitory units (TUs) and so were enumerated as such.

Table 62. LUCA True Adds Enumeration Results for HUs, GQs, and TLs

	LUCA Addresses Sent to Enumeration	Percent of Addresses Sent for Enumeration	LUCA addresses enumerated	LUCA addresses found as vacant (Subset of Enumerated)	LUCA Addresses Not in 2020 Census
Total	**3,217,000**		37.6%	26.5%	62.4%
HUs	3,187,000	99.1%	37.6%	26.6%	62.4%
GQs	20,500	0.6%	40.1%	2.3%	59.9%
TLs	9,300	0.3%	13.2%	92.0%	86.8%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Table 63 shows enumeration results of LUCA addresses by entity size and Table 64 shows enumeration results of LUCA true adds by entity size. Overall, LUCA entities with 50,001 to 100,000 records had the highest rate of enumeration, at 85.0 percent, and the entities with more than 1 million addresses had the lowest enumeration rate, at 65.6 percent. Entities with fewer than 1,000 addresses had the highest enumeration rate for LUCA true adds, at 51.6

percent, and entities with more than 1 million addresses had the lowest enumeration rate for LUCA true adds, at 24.7 percent.

For the 2010 LUCA operation, the Census Bureau enumerated 64.1 percent of new addresses submitted by entities with fewer than 1,000 addresses, the highest enumeration rate for new (true) adds in the 2010 LUCA operation. For comparison, the Census Bureau enumerated only 21.8 percent of new addresses submitted by entities with more than 1 million addresses, which represented the lowest enumeration rate for entities by size.

Table 63. LUCA Addresses Enumeration Results by Entity Size

	LUCA Addresses Sent to Enumeration	Percent of Addresses Sent to Enumeration	LUCA Addresses Enumerated	LUCA Addresses Found as Vacant (Subset of Enumerated)	LUCA Addresses Not in Census
Total	**18,450,000***		**80.5%**	**11.8%**	**19.5**
1,000 or Fewer Addresses	116,000	0.6%	77.2%	15.1%	22.8%
1,001 – 6,000 Addresses	697,000	3.8%	78.0%	16.5%	22.0%
6,001 – 50,000 Addresses	5,187,000	28.1%	81.9%	12.8%	18.1%
50,001 – 100,000 Addresses	2,371,000	12.8%	85.0%	11.0%	15.0%
100,001 – 1,000,000 Addresses	6,966,000	37.7%	84.9%	10.8%	15.1%
1,000,001 or More Addresses	3,117,000	16.9%	65.6%	12.3%	34.4%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
*Total number of addresses is the count of MAFIDs in the enumeration universe with MAFSRC 205 or 206 - the count of MAFIDS with MAFSOURCE 205 and 206 linked back to LMT/PCS Universe Table.
Note: This count will not match base count of LUCA records in enumeration universe because of multiple entities submitting records more than once.

Table 64. LUCA True Adds Enumeration Results by Entity Size

	LUCA Addresses Sent to Enumeration	Percent of Addresses Sent to Enumeration	LUCA Addresses Enumerated	LUCA addresses found as vacant (Subset of Enumerated)	LUCA Addresses Not in Census
Total	**3,217,000**		**37.6%**	**26.5%**	**62.4%**
1,000 or Fewer Addresses	22,000	0.7%	51.6%	25.3%	48.4%
1,001 – 6,000 Addresses	152,000	4.7%	45.6%	34.1%	54.4%
6,001 – 50,000 Addresses	845,000	26.3%	42.7%	30.2%	57.3%
50,001 – 100,000 Addresses	328,000	10.2%	47.2%	26.0%	52.8%
100,001 – 1,000,000 Addresses	911,000	28.3%	41.2%	24.2%	58.8%
1,000,001 or More Addresses	960,000	29.8%	24.7%	22.6%	75.3%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
Total number of addresses is the count of MAFIDs in the enumeration universe with MAFSRC 205 or 206 - the count of MAFIDS with MAFSRC 205 and 206 linked back to LMT/PCS Universe Table.

Table 65 shows enumeration results of LUCA addresses by entity type and Table 66 shows enumeration results of LUCA true adds by entity type.

Overall, MCDs had the highest rate of LUCA record enumeration, at 86.1 percent, and AIAs had the lowest enumeration rate, at 72.7 percent. However, AIAs had the highest enumeration rate for LUCA true adds at 57.9 percent, and states had the lowest enumeration rate for LUCA true adds, at 34.1 percent.

For true adds from the 2010 LUCA operation, the Census Bureau enumerated addresses from MCDs at a rate of 52.2 percent, the highest rate by entity type. The lowest rate of 2010 enumeration for LUCA true adds came from AIAs, with a rate of 26.3 percent.

Table 65. LUCA Addresses Enumeration Results by Entity Type

	LUCA Addresses Sent to Enumeration	Percent of Addresses Sent to Enumeration	LUCA Addresses Enumerated	LUCA Addresses Found as Vacant (Subset of Enumerated)	LUCA Addresses Not in Census
Total	**18,460,000***		**80.5%**	**11.8%**	**19.5%**
AIA	27,500	0.1%	72.7%	15.1%	27.3%
State	2,762,000	15.0%	75.9%	13.1%	24.1%
County	8,587,000	46.5%	81.5%	12.4%	18.5%
MCD	346,000	1.9%	86.1%	11.3%	13.9%
Place	6,734,000	36.5%	80.8%	10.7%	19.2%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
*Note: Discrepancy of 2,900 in totals for this table and table by size (Table 64) results from records being counted more than once. For example, if a city and state both have the same record, they were counted separately in the state and place category in this table, but then were counted only once in Table 64 in the >=1,000,001 category.

Table 66. LUCA True Adds Enumeration Results by Entity Type

	LUCA Addresses Sent to Enumeration	Percent of Addresses Sent to Enumeration	LUCA Addresses Enumerated	LUCA Addresses Found as Vacant (Subset of Enumerated)	LUCA Addresses Not in Census
Total	**3,217,000**		**37.6%**	**26.5%**	**62.4%**
AIA	11,000	0.3%	57.9%	20.9%	42.1%
State	519,000	16.1%	34.1%	30.6%	65.9%
County	1,328,000	41.3%	38.5%	32.0%	61.5%
MCD	56,500	1.8%	55.1%	29.1%	44.9%
Place	1,303,000	40.5%	37.1%	19.1%	62.9%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

5.24 What were the results of the appeals process?

For each appeal, the Appeals Office reviewed the address list submission, written narrative, evidence, and other supporting documentation submitted by the appealing entity. The Appeals Office reviewed each assigned case to consider the quality of the evidentiary source as the basis for determining the validity of an address (or group of addresses) and their locations. In some cases, the Appeals Officers used independent research (e.g., imagery, local government GIS systems, and tax data) to supplement the materials provided by the appellant. From this analysis, the Appeals Officer judged the validity of an appealed address (or group of addresses) and whether or not they should be accepted or rejected.

Table 67 shows that out of the 6,955 entities eligible for the LUCA Appeals process, 19.2 percent (1,333) submitted an appeal. The Appeals Office received a total of 127,000 addresses to review and it accepted 58.8 percent of these addresses after conducting the review.

Table 67. LUCA Appeals Results

	Count	Percent
LUCA Entities Eligible for Appeals*	6,955	
LUCA Entities Submitting Appeals	1,333	19.2%
LUCA Appealed Addresses	127,000	
LUCA Appealed Addresses Accepted by OMB Appeals Office	74,500	58.8%

Source: LUCA Master Table and OMB LUCA Appeals Report.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.
*There were 268 entities that received feedback that did not have addresses that could be appealed.

During the 2010 LUCA operation, 7,587 participants were eligible to file appeals and 2,418 participants (31.9 percent) filed appeals. Participants appealed 1,796,167 addresses; of these, 1,634,497 (91 percent) of addresses were accepted and 161,670 were rejected. This means that a smaller percentage of 2020 LUCA entities appealed addresses, many fewer addresses were appealed during the 2020 operation, and the OMB accepted fewer of the appealed 2020 addresses.

5.25 What were the enumeration results for LUCA Appealed addresses?

Of the address records that OMB approved during the LUCA Appeals process, 95.5 percent actually updated the MAF and received a LUCA Appeals source code. The 4.5 percent difference could result from either rejection at update or from duplicates that resulted in only one distinct MAFID receiving the source code. For example, a state and county may have appealed the same address record and OMB subsequently approved both, so would have been counted only once in the update process.

Table 68 shows details about the appealed LUCA addresses in the supplemental enumeration universe and their enumeration results. These data show the impact to the supplemental enumeration universe from LUCA appeals.

Table 68. LUCA Appealed Housing Unit Addresses in Supplemental Enumeration

	Count	Percent of Records that Updated the MAF
LUCA Appealed records, total	**74,500**	
LUCA Appealed records that updated the MAF	**71,500**	100%
Not in Supplemental Enumeration Universe*		41.9%
In Supplemental Enumeration Universe		58.1%
Enumerated		**47.0%**
Occupied		*70.8%*
Vacant		*29.2%*
Not Enumerated		**53.0%**
Housing Unit Not in 2020 Census		*95.9%*
Retired duplicate		*4.1%*

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.
Tallies are based on the total number of records with the LUCA Appeals source (MAFSRC 216) that were included in the supplemental universe (SUPNRFUUNV = H) and were officially enumerated or enumerated as vacant (enumerated as vacant is a subset of enumerated records).
*The numbers in the rows will not sum because many LUCA Appeals records that updated the MAF already existed in the enumeration universe.

Of the appealed addresses that updated the MAF, 58.1 percent went on to be included in the supplemental enumeration universe because the Census Bureau found many of these records already existed on the MAF, likely as a results of concurrent address updating operations. Appeals addresses required evidence from the participating government to substantiate the appeal. The Census Bureau enumerated 47.0 percent of the appealed records in the supplemental enumeration universe. Of the enumerated records, the Census Bureau determined 29.2 percent to be vacant.

Of the enumerated appealed records, about 40 percent were records that LUCA initially rejected for update because the records had been updated by another operation or participating LUCA entity (X01 codes). Many of the remaining 60 percent of records received R03 feedback codes, which were rejected adds from partners. In these scenarios, LUCA rejected the records because of a high level of confidence that the addresses did not represent living quarters. If a reviewer rejected it, these were the common reasons:

- The dwelling existed but the Census Bureau believed it was used for nonresidential purposes.
- The address represented something other than a dwelling (such as fire hydrants, utility poles, etc.).
- There was no visible dwelling present at the address location.

Reasons for rejected addresses to be found and enumerated could include new growth not depicted in imagery that was used or built in the 12-18 months between validating the

addresses and Census Day, or in cases where structures may have been converted from commercial to residential use.

After the 2010 LUCA operation, the Census Bureau enumerated 56 percent of the appealed records.

Table 69 shows a breakdown of the appealed GQ/TL addresses that went to the GQ Production Control System (GQPCS).

Table 69. LUCA Appealed Group Quarters and Transitory Locations Addresses

	Count	Percent
Sent to GQ Advance Contact and TL Advance Contact	**550**	
Did not Move to GQE/ETL		33.3%
Moved on to GQE/ETL		66.7%
Enumerated		**57.8%**
Vacant		*1.4%*
Occupied		*98.6%*
Not Enumerated		**42.2%**
Not a Housing Unit for the 2020 Census		*16.1%*
Vacant Group Quarter		*31.6%*
Nonexistent Group Quarter		*3.2%*
Unknown Status		-
Duplicate Group Quarter		*1.3%*
Nonresidential Group Quarter		*0.6%*
Retired Duplicate		*47.1%*

Source: GQPCS.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report. Numbers may not sum because of rounding.

Of the approved LUCA Appeals GQ/TL addresses, 33.3 percent did not move onto enumeration operations, while 66.7 percent went to Group Quarters Enumeration (GQE) or Enumeration at Transitory Locations (ETL). Of the approved GQ/TL addresses that moved on to enumeration, 57.8 percent were enumerated, and 42.2 percent were not enumerated. Table 70 shows details about HUs within the appealed LUCA addresses by entity size.

Table 70. LUCA Appealed Housing Unit Address Results by Entity Size

	Total	Percent of Appealed Addresses	Enumerated	Vacant (subset of enumerated)	Housing Unit Not in 2020 Census	Retired Duplicate
Total	**41,500**					
			47.0%	29.2%	50.9%	2.2%
1,000 or Fewer Addresses	400	1.0%				
			64.9%	22.8%	32.5%	2.6%
1,001 – 6,000 Addresses	1,900	4.6%				
			67.6%	28.1%	28.5%	3.8%
6,001 – 50,000 Addresses	11,500	28.2%				
			65.9%	35.4%	32.6%	1.5%
50,001 – 100,000 Addresses	3,600	8.7%				
			50.6%	26.6%	46.6%	2.8%
100,001 – 1,000,000 Addresses	15,500	37.5%				
			35.5%	23.6%	63.3%	1.2%
1,000,001 or More Addresses	8,300	19.9%				
			34.4%	26.1%	61.4%	4.2%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.
Percent of vacant was calculated using the number of enumerated records as the denominator.

Of approved LUCA Appeals records included in the Supplemental Enumeration Universe, the largest portion (37.5 percent) came from entities that contained 100,001 to 1,000,00 addresses. Of the addresses from the entities that included 100,001 to 1,000,000 addresses, 35.5 percent were enumerated and of these, 23.6 percent of the enumerated addresses were vacant. The larger entities had fewer of their LUCA Appeals addresses enumerated. Entities with more than 1 million addresses saw the lowest rate of enumeration for LUCA Appeals addresses, at 34.4 percent, and entities with 1,001 to 6,000 addresses saw the highest rate, at 67.6 percent.

Table 71 shows details about HUs within the appealed LUCA addresses by entity type.

Table 71. LUCA Appealed Housing Unit Address Results by Entity Type

	Total	Percent of Appealed Addresses	Enumerated	Vacant (subset of enumerated)	Housing Unit Not in 2020 Census	Retired Duplicate
Total	**41,448**					
			47.0%	29.2%	50.9%	2.2%
AIA	300	0.8%				
			70.3%	34.4%	19.2%	10.5%
ST	5,500	13.2%				
			44.0%	31.4%	50.0%	6.0%
CO	24,000	57.6%				
			46.2%	17.9%	52.9%	0.9%
MCD	1,000	2.4%				
			64.7%	17.7%	35.0%	0.3%
PL	11,000	26.1%				
			47.7%	53.6%	49.4%	2.9%

Source: LUCA Master Table.
Note: The data in this table have been rounded or injected with noise as part of the Census Bureau's approved disclosure avoidance practices applied to this report.
Percent of vacant was calculated using the number of enumerated records as the denominator.

Counties contributed the largest proportion (57.6 percent) of the records from the LUCA Appeals process that entered the supplemental enumeration universe. The Census Bureau enumerated 70.3 percent of the LUCA Appeals addresses from AIA entities, the highest rate by entity type for appealed addresses. The Census Bureau enumerated 44.0 percent of the records appealed by states, the lowest enumeration rate by entity type.

5.26 How many phone calls from entities were received by the Help Desk and by the RCCs and what was the nature of the calls?

The Geographic Partnership Support Desk (GPSD) summarized phone calls from entities using daily call reports. Table 72 shows a summary of the calls that LUCA entities made to the GPSD.

Table 72. Number of Phone Calls from LUCA Entities

	Count	Percent
Total Number of Calls Received	15,128	
Resolved by Tier 1	8,484	56.1%
Escalated and Resolved by Tier 2	2,487	16.4%
Escalated and Resolved by Tier 3	4,157	27.5%

Source: GPSD/DCMD.

Although LUCA entities made 15,128 support desk calls, GPSD may have recorded multiple reasons for each call. For example, an entity could have experienced a password issue and also had a question about the specific program (in this case, LUCA). GPSD routed GUPS questions and SWIM/Password issues to Tier 2, while program-specific questions went to Tier 3 for

resolution. The above table shows information for calls that initially went through Tier 1, though RCCs received some calls directly. Table 73 shows the top reasons for LUCA entity support desk calls.

Table 73. Top Reasons for Phone Calls for LUCA Entities

	Count
Answered LUCA-specific questions	5,208
Other (such as GUPS-related questions, etc.)	2,729
Password assistance	963
Updated contact info for caller	842
SWIM token assistance	426

Source: GPSD/DCMD.

5.27 How did budgeted costs compare with actual costs in the 2020 LUCA budget?

The Census Bureau budgeted a total of $28,660,532 for the LUCA operation and spent $23,770,478 on the operation, with a variance of $4,890,054 and a variance percentage of 17.1. As shown in Table 74, the LUCA operation completed its work within budget. Costs include project management activities, software development and testing, production work and processing, as well as assessment development activities through fiscal year 2021.

The In-Office Address Canvassing operation included LAV, which included a higher-than-expected workload, so the LAV costs are not included here but are shown in the In-Office Address Canvassing Operational Assessment Report (Richmond et al., 2022).

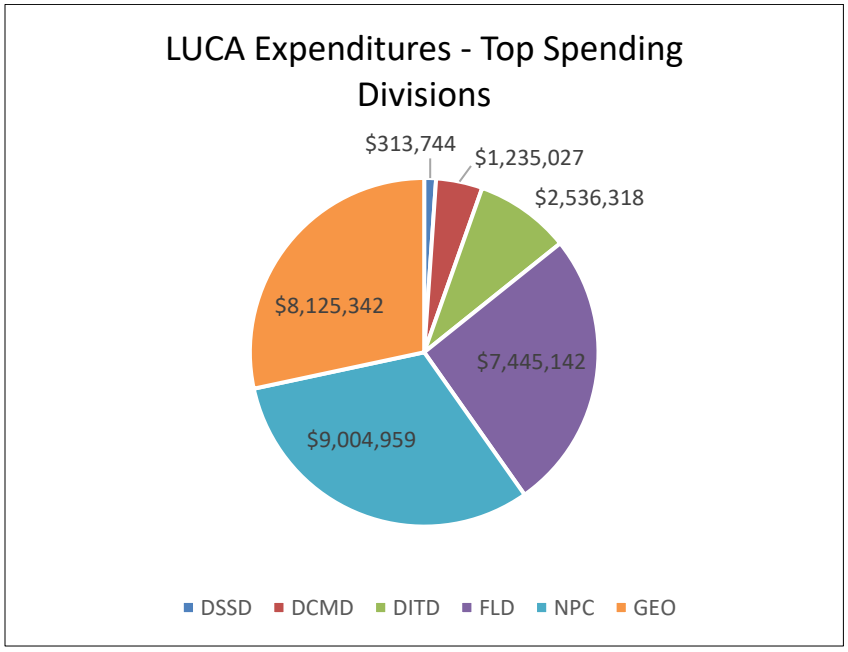
Table 74. Summary of Budget, Actual Costs, and Variance for the LUCA Operation by Fiscal Year

Division	Planned Costs	Actual Costs	Variance	Variance %
ADDC	$0	$100	($100)	
ADDP	$0	$309	($309)	
ADRM	$0	$10,451	($10,451)	
CBSM	$0	$0	$0	
CLMSO	$0	$426	($426)	
DCMD	$1,235,027	$1,064,126	$170,901	13.8%
DIR	$0	$0	$0	
DITD	$2,536,318	$2,238,632	$297,686	11.7%
DO	$0	($789)	$789	
DSSD	$313,744	$116,700	$197,044	62.8%
ERD	$0	$0	$0	
FLD	$7,445,142	$5,595,741	$1,849,401	24.8%
GEO	$8,125,342	$8,634,155	($508,813)	-6.3%
NPC	$9,004,959	$6,103,080	$2,901,879	32.2%
OCIA	$0	$6,802	($6,802)	
PIO	$0	$746	($746)	
Grand Total	**$28,660,532**	**$23,770,478**	**$4,890,054**	**17.1%**

Source: Decennial Budget Office.

Error! Reference source not found. shows the six top-spending Census Bureau divisions for the L UCA operation. GEO, NPC, and FLD Divisions, respectively, spent the most to complete the LUCA operation. Additional information showing budget, expenditures, and variance by division and fiscal year can be found in Appendix B, Table 84.

Figure 2. Total LUCA Operation Costs by Census Bureau Division



Source: Decennial Budget Office.

6. Conclusions and Recommendations

6.1 Conclusions

Overall, the Census Bureau completed a successful Local Update of Census (LUCA) operation, providing an opportunity for tribal, state, and local entities to review and improve the address lists and maps used to conduct the 2020 Census. A summary of key successes, challenges, and recommendations for future operations, in no specific order, follows below.

After LUCA received Office of Management and Budget (OMB) approval in December 2016, the operation sent out advance notices to eligible tribal, state, county, and local entities in January 2017. Invitation and registration occurred from July 2017 to August 2018 where 39,327 entities were invited and 11,549 registered for LUCA. Participants reviewed the Census Bureau's address list and sent their updates back from March through November 2018. The Census Bureau received 8,628 submissions and of those, about 17.5 percent were received late without an extension. Of 17.5 percent received late without an extension, the Census Bureau processed 76 percent because the remainder arrived too late to be included in the April 2019 update process.

From the submissions that were received in time to process, LUCA received 22,670,000 address updates and processed 97.7 percent of the address updates. The Census Bureau processed LUCA returns, conducted LUCA Address Validation, and updated the Master Address File (MAF) from March 2019 to April 2019. About 81 percent of the more than 22 million addresses sent to matching matched to the MAF. While adds that do not match to the MAF are often new addresses, they sometimes can be duplicate addresses that were formatted differently than the MAF address. Of the adds that did not match to the MAF, 37.6 percent were enumerated or found vacant, meaning they were most likely a good address, and 62.4 percent were not enumerated, meaning most likely they were not a valid address at the time of the 2020 Census. In total, about 5.3 percent of all address updates received in LUCA were adds that did not match the MAF and were enumerated in the 2020 Census.

Feedback materials were sent to eligible participants from July to September 2019. OMB processed LUCA appeals from September 2019 to February 2020. Of the 6,955 entities eligible for appeals, 19.2 percent submitted an appeal to their LUCA feedback. Of the appealed addresses, the OMB appeals office accepted 58.8 percent. The Census Bureau enumerated 47.0 percent of the appealed records in the supplemental enumeration universe. During LUCA, the Geographic Partnership Support Desk (GPSD) received 15,128 calls. The actual cost of LUCA was $23,770,478 which was under budget.

6.2 Summary of Successes

1. Recommendations from 2010 LUCA were successfully applied to 2020 LUCA. These included:

- Eliminating the option for LUCA participants to submit their full address list without

comparing it to the Census Bureau's address list and identifying the differences.

- Including MAF structure coordinates (latitude and longitude) in the Census Bureau address list and allowing participants to return their structure coordinates as part of their submission.
- Providing ungeocoded United States Postal Service (USPS) Delivery Sequence File (DSF) addresses to state and county partners.
- Providing the address list in more standard formats.
- Including an in-office verification of LUCA submitted addresses, which occurred in LUCA Address Validation.
- Using Geographic Support System (GSS) tools and data to validate LUCA submissions.
- Requiring unit designators for multiunit structures.
- Providing participants in areas with non-city-style addresses with updated address lists and maps during the feedback phase rather than having them challenge counts by blocks.

2. The GPSD used a centralized staff to answer initial questions about LUCA, which took pressure off the regional census centers (RCCs), and helped participants use Geographic Update Partnership Software (GUPS). The GPSD was new for 2020 and provided additional customer support, a useful dashboard and reports, and good metrics to inform 2030 planning.

3. Promotional workshops for LUCA participants were successful overall[7] and helped 2020 LUCA conduct outreach. These included 690 promotional workshops that the RCCs and Field Division conducted as well as LUCA workshops at Office of Congressional and Intergovernmental Affairs (OCIA), events which reached a wide audience.

4. LUCA activities at the National Processing Center (NPC) had many successes. For example, staff learned from each mailing and successfully applied improvements to the next mailing. During LUCA, staff from Geography Division (GEO) provided floor support at NPC and it was helpful for troubleshooting issues. Overall, the organization and QC of activities at NPC was successful.

5. Partners liked the D-2209 FB Address Count List and used the counts to decide whether they were going to file an appeal.

6.3 Summary of Challenges

Overall, LUCA was successful. However, the team identified improvements that could be made for the future. The challenges are described in detail below. The next section (6.4) will list all recommendations.

1. The framework of the 2020 LUCA needed early decade decisions, funding, and stakeholder agreement. Because of the timing of decisions and funding in 2020 LUCA, the operation

[7] While the Census Bureau did not conduct a formal survey, partners attending these trainings provided verbal feedback that they found that trainings helpful.

required multifaceted mitigation measures to be successful:

- The large set of participant materials required multiple revisions, which took additional time and resources. While LUCA staff were writing the materials, some program details were undecided or lacked agreement, software was still in development, and changes in management occurred. Because of the number of materials and the fact that they also had to be translated into Spanish and made 508 compliant, coordinating changes and ensuring uniformity across the set of materials took extra time and resources.
- For the NPC digital and paper submission review, the procedures were changed substantially after the activity began. In 2010 LUCA, regional geographers and specialists processed LUCA submissions and their processing procedures were high level because of the expertise of these staff. In 2020 LUCA, with processing moving to cartographic techs and clerks at NPC, the procedures needed to be rewritten and much more detailed since these staff were a different grade level and may not have had LUCA experience like the regional geographers. Additionally, in 2020 LUCA, headquarters staff spent additional time and resources on the LUCA participant materials. As a result, the processing procedures headquarters LUCA staff originally gave to NPC were not sufficient and headquarters LUCA staff needed to revise the procedures. To mitigate this issue, NPC staff started inputting LUCA paper submissions into GUPS while they waited on the processing procedures.
- The Production Control System (PCS) is vital for coordinating LUCA. In 2020 LUCA, most modules were developed after the program started because of both resource issues and changes to requirements. As a result, in some modules, staff were unable to manually enter data at the time needed and later had to program the data into to the PCS tables, which caused blanks and other data issues within the PCS. Additionally, the universe of potential LUCA participants for the PCS was created in an ad-hoc fashion, needed better coordination, required changes throughout the operation and made it difficult to compare values from different PCS data tables. Finally, the PCS was taught differently in trainings than how it would be used later because of functionality changes.
- Policies such as how and when to give participants extensions and thresholds for the entity level checks were needed but lack of universal agreement caused confusion and required additional staff time and resources.

The LUCA operation presented unique challenges: contacting and tracking registration for more than 39,000 entities, processing and providing feedback for millions of addresses (more than 22 million in 2020) of addresses, and complying with Title 13 while sharing data with partners. Because of the complexity and scale of the operation, changes to LUCA rippled out and affected many materials, systems, and processes. LUCA required stakeholder agreement, resources, and funding early in the decade to minimize changes to the operation that take additional time and resources.

2. Some Census Bureau LUCA stakeholders and staff had different goals and expectations for 2020 LUCA, which sometimes created conflicting priorities:

- Field and regional office staff often spent time working directly with partners either

because participants had special requests or because this model had been used in LUCA in the past to boost participation. In 2020 LUCA, the time needed from subject matter experts (SMEs) to answer questions from LUCA participants did not align with the resources of the operation.

- In previous decades, a key metric for LUCA was the number of registered participants. Some internal stakeholders expected this to be a key metric for 2020 LUCA while others expected the quality of the addresses submitted to be the key metric. 2020 LUCA performed additional outreach to boost registration and reported the progress of registration numbers to executive staff.
- The roles and responsibilities of internal stakeholders in creating or approving materials were not always clear and led to a more challenging material creation process. As mentioned in challenge one, there were multiple factors that made the process more complicated including program details that were undecided or lacked agreement, software in progress, and changes in management. However, creating and approving LUCA materials was also complicated by unclear roles and responsibilities for stakeholders, often with too many stakeholders involved in the approval process.

Among LUCA stakeholders, there were sometimes different approaches to the work of the regional office staff and requests from partners, such as when to grant extensions to participants, and this resulted in additional work for LUCA staff. Part of this challenge is because of changes over time in the nature of address work and the availability of information. In past LUCA operations, the Census Bureau sought to get as many entities involved as possible and collect new addresses for the MAF. Over time, the MAF has become more complete with additional address programs such as GSS and the biannual DSF updates. Additionally, multiple entities commonly manage overlapping address inventories such as cities, counties, and states. Because of these changes, some internal stakeholders prioritized the quality of addresses and MAF coverage while other internal stakeholders prioritized getting as many LUCA participants as possible like in past LUCA operations.

LUCA is a high-profile operation and one of the first to conduct decennial outreach with multiple levels of entities. As a result, several areas across several divisions all had strong opinions about how LUCA materials should look, what they should or should not contain, and even what wording or formatting should or should not be used. Additionally, staff discovered that more SME involvement was needed in writing the respondent guides because they had inaccuracies and needed revisions after they were written.

3. From the perspective of participants, LUCA terms and processes were sometimes unclear or cumbersome. While the 2020 LUCA operation did make an effort to simplify the materials and options for partners, partners still found many parts of LUCA unclear in 2020. Although the LUCA operation is not alone in this challenge, the scale, timeframe, and Title 13 legal requirements of LUCA amplified the effects of unclear materials or processes and caused more work for both participants and Census Bureau staff. Overall, a lack of partner understanding caused additional logistical work (e.g., answering a high volume of questions about passwords) as well as submissions that did not meet the Census Bureau's standards and took more time to

process.

Many LUCA participants wanted to ensure their addresses were included in the census but often misunderstood what kinds of differences between their address list and the Census Bureau's address list would result in addresses not being included in the census.

The following are examples where participants did not understand LUCA materials or processes:

- Partners added new addresses when they did not see an exact match on the Census Bureau address list without understanding the principles of Census Bureau address matching.
- There were many LUCA materials and forms, which was sometimes overwhelming for participants.
- Many participants were confused about the categorizations of the mailings. For example, Advance Notice vs. Registration and Follow-up vs. reminder mailings.
- Feedback code names and definitions reflected internal Census Bureau processing and were confusing to participants.
- Some participants misunderstood the "out of jurisdiction" action. The Census Bureau intended participants to mark an address outside their city limits with this action, but some participants interpreted this action to pertain to a (nonindependent) city within a county.
- Some participants were wary of signing the Confidentiality Agreement Form, which had very technical language without any plain language to explain what the form meant.
- Some of the form questions did not apply to all participants or types of entities. This caused confusion and required late change to the form to account for "N/A" use.
- Participants needed to fill out four forms to register: the registration form, the product preference form, the confidentiality agreement, and the confidentiality checklist. Many entities struggled with the complicated registration process, and it took time and resources to follow up with entities to get them fully registered before the deadline.
- The LUCA registration forms were not fillable PDFs.
- Governments were confused by the LUCA Closeout letter emails and called the LUCA Appeals Office with concerns. Because participants were confused, LUCA held the remaining emails for another two months while they worked with participants.
- Some of the logistics of LUCA were confusing to participants. For example, it was common for participants to ask why they did not receive their password letter. Some participants were confused about the password itself because it ended with an exclamation mark, which they interpreted as punctuation rather than as part of the password. Participants were also confused during feedback about needing two passwords (a review password to see their submission and a feedback password) in GUPS.

4. 2020 LUCA experienced challenges in submissions. As described in challenge three,

sometimes 2020 LUCA materials were unclear, which sometimes caused logistical issues as well as issues in submissions. The result of these issues in submissions was that both the participants and the Census Bureau spent additional time on LUCA but often without positively affecting the quality of the MAF.

- Participants often submitted corrections or changes to existing MAF records that were in a standardized MAF format or that the Census Bureau believed were good addresses, such as those reviewed by a geographer or having a long DSF history. For example, a LUCA participant changing the DSF version "Unit 5" to "Apt 5." These types of changes were time-consuming to process but often did not improve the quality of the MAF. Additionally, many participants edited address components that were ineligible for updating (such as house number), which complicated processing for the Census Bureau.
- Some participants had specific requests or did not understand why the Census Bureau did not take some of their address updates and escalated their queries to regional office executive staff who relayed the questions to headquarters senior staff. These inquires then came to LUCA SMEs at a time when their workload was high.
- Some participants attempted to delete addresses that the Census Bureau believed were good addresses, which caused extra work for LUCA staff but often did not result in any address changes.
- Some county participants misunderstood the "out of jurisdiction" action and used this action on all addresses within incorporated places within their county, possibly because their business needs are different and because the user guide did not explain this action clearly. Regardless of the cause, it resulted in additional work in processing and was ultimately not useful for MAF update purposes.
- The digital files that participants sent to the Census Bureau were often inconsistent in formatting, which required additional processing time. Additional issues in data sharing such as special characters or leading zeros and different file formats caused issues and required additional processing.

Partners for geographic programs, including LUCA, are often enthusiastic about sharing data but sometimes have different business needs or want to work at a level that goes beyond the needs of the geographic frame. Most commonly, these partners wish to make corrections that take resources for the Census Bureau to process but do not improve the geographic frame or do not change the way the Census Bureau enumerates people. These partners may believe that enumeration errors will occur without these corrections or may simply desire that their jurisdiction's data looks a certain way in MAF/TIGER. The Census Bureau does not have unlimited resources and needs to maintain address standards for the MAF. Because of these differing needs or expectations, some LUCA partners were very vocal about their desires, resulting in the need for appeasement, which often created more work for LUCA staff.

Overall, partners submitted many changes that required time and resources to process but did not affect enumeration for the 2020 Census. While it is not possible to completely eliminate LUCA participants sending undesirable changes, 2020 LUCA showed that there is a need to find ways to further reduce submissions that do not improve the quality of the MAF as well as

submissions that require additional processing because of formatting issues. LUCA participants often have different business needs in their address data than the Census Bureau and LUCA materials do not always adequately explain what the Census Bureau does or does not want in submissions.

5. The Census Bureau experienced challenges with creating the mailing extracts, particularly in the Advance Notice mailing, because of insufficient resources and the challenging nature of overlapping or complex relationships that some entities or their contacts have.

- A small percentage of entities were missing from the advance notice mailing but were added to the universe later because of an error with the initial criteria used to define the list of eligible governments.
- There were not enough programming resources to support LUCA using the Geographic Program Participant System (GPP), especially directly before the Advance Notice in January after many were out in December with the holidays or end of the year expiring leave, and as a result, the mailing extract had multiple issues.
- There were not enough tribal SME resources to help with defining the universe and how to mail to tribes with complex or multiple land to tribe relationships.
- More time was needed to interactively review and correct the mailing extract.
- Some LUCA contacts were outdated or programming specifications unintentionally specified contact groups that were not ideal.
- Some LUCA contacts received multiple forms, sometimes duplicates and sometimes each for a different geography. From the recipient's perspective, these multiple forms created confusion.

6. Some of the aspects of coordinating registration, mailing, and processing for LUCA were not ideal and caused additional work. LUCA is a large operation with many phases and required a high level of coordination among multiple divisions and areas and streamlined processes.

- There were no simulated files for testing LUCA processes or a soft start where there was a scheduled time to work out any issues. Without test data or a soft start, processes experienced a backlog initially while staff quickly worked to resolve the issues.
- LUCA registration required many forms and because there were so many forms and the process was not always clear to participants, NPC and regional office staff had to conduct additional follow-up for missing or incomplete forms. Additionally, the demands of paper registration also added additional work for NPC and regional office staff.
- As mentioned in challenges one and two, there was not a universal policy on extensions and the patchwork of extensions complicated internal processes.
- There was not always a clear link between fields on the registration forms and fields in the GPP or PCS and this made the process for keying data more complicated, contributed to keying errors in both the GPP and PCS, and sometimes created errors in an entity's registration. Additionally, some staff used "shortcuts" in these systems to quickly achieve a desired result, such as sending participant materials, without realizing

that they were compromising data in other parts of the system.

- LUCA Address Validation was a separate process and managed by a separate team as part of In-Office Address Canvassing (IOAC). While LUCA Address Validation was completed successfully, there was some internal confusion at times.

7. After the Census Bureau collected Global Positioning System (GPS) coordinates for addresses in the 2010 Census Address Canvassing, the Census Bureau decided to provide 2020 LUCA participants with coordinate data and invite them to edit or add coordinates. The Census Bureau encountered a few issues in processing coordinates:

- Some participants adjusted either the longitude or latitude but not both, which resulted in the GPS point for the address being in a different location than the address. As a result, these cases could not go through automated processing and took more time and resources to process.
- Some participants provided coordinates as well as the state, census tract, and block (another way of providing location) and the two forms of geocoding conflicted. In these cases, LUCA staff had to research which location was correct, which again meant that these addresses could not go through automated processing and LUCA staff needed to provide additional time and resources to process the addresses.
- Instead of providing the coordinates of the housing unit for the address, some participants provided the center location of the ZIP Code for the address, called the ZIP centroid. In most cases, the ZIP centroid is in a different census block than the address, which again required additional time and resources in processing.

8. 2020 LUCA did not require Zone Improvement Plan (ZIP) Codes because some entities have addresses without ZIP Codes for e911 purposes. However, in cases where the address did have a ZIP Code, but the participant did not submit the ZIP Code as part of the address, it affected matching and coding in processing, which took additional time and resources for LUCA to process the address.

For addresses submitted in LUCA without a ZIP Code, they failed automated matching to the MAF and were then matched against past GSS submissions and PEARSIS. If they still failed to gain a match, the address was sent to LUCA Address Validation. If the address had coordinates (latitude and longitude) LUCA Address Validation reviewers attempted to conduct research. If the address lacked coordinates and a ZIP Code, LUCA Address Validation reviewers rejected the address, which meant that it would not have the potential to be included in the census unless successfully appealed. Overall, addresses that had ZIP Codes but were submitted without them required additional time and resources to process but many were rejected in the end.

6.4 Recommendations

Recommendation 1: Create a LUCA Steering Committee

The LUCA Steering Committee should create a common vision for the operation and a unified message to LUCA participants, define roles and responsibilities within the Census Bureau, and

establish measures of success for the operation. As described in challenges one and two, there were many stakeholders for LUCA and they often disagreed on aspects of the operation, which caused rework and sometimes a conflicting response to partners. Additionally, LUCA requires early decade decisions and funding as well as coordination among many areas of the Census Bureau.

The steering committee for LUCA should allow the operation to involve key stakeholders in decisions, form consensus, and get support so LUCA can develop software, create materials, and apply for OMB approval with a complete plan for the operation in place thus reducing the need for rework. Additionally, the steering committee should make key policies for LUCA such as a universal policy for giving extensions to participants. These policies should be used by all Census Bureau staff working on LUCA so that the operation has a unified vision. Finally, the steering committee should create a process for change control and manage any changes to the operation. For additional information about how these relate to making the LUCA operation clearer more efficient for external stakeholders, please see Recommendation 3.

Recommendation 2: Define LUCA expectations for participants and the Census Bureau

2030 LUCA should outline for participants what they can expect from LUCA and how LUCA ties into the decennial census for their jurisdiction. These expectations should include clear policies, in plain language, on what the Census Bureau can and cannot do, including why, that can be referred to when participants have requests that the Census Bureau does not have the resources for. As described in challenges two and three, some LUCA participants had expectations for LUCA that were not aligned with the operation or with the Census Bureau's level of resources and these participants were vocal about their desires, often requiring appeasement that took additional time and resources for LUCA staff. The 2020 LUCA guides had some language about what participants can expect from the Census Bureau and 2030 LUCA should take this further by adding more details and making a clear list of "roles and responsibilities" for both the Census Bureau and LUCA participants.

The address frame has evolved over the decades that LUCA has been conducted and while past LUCA operations needed to gather as many addresses as possible, the maturity of the address frame and the addition of other resources (such as the DSF) has changed what LUCA needs from participants. It is important that the Census Bureau communicate to participants the goals and expectations of 2030 LUCA and the reasons behind them. For example, if 2030 LUCA were to accept only add and delete actions, some participants may send or request time-consuming change actions or escalate their requests to senior officials. Having clear expectations and policies will help keep these requests from causing additional work that does not improve the quality of the address frame as well as communicate to participants what they can expect from the Census Bureau. Finally, LUCA should link these expectations or responsibilities to decennial messaging and the role of LUCA in the 2030 Census. For this link to the 2030 Census, LUCA staff should work with the Communications Directorate. LUCA staff should also work with the Communications Directorate on crafting expectations for LUCA that are clear in detail and positive in tone.

Recommendation 3: Make LUCA materials clearer for participants by applying plain language, streamlining materials, involving address subject matter experts, and outlining the entire LUCA process.

In 2020 LUCA, the material creation process was lengthy and complicated for the Census Bureau (challenges one and two) and LUCA materials and processes were often unclear to participants (challenge three). In 2030 LUCA, when developing a plan for LUCA materials, the Census Bureau should consider LUCA from the participant perspective and strategies for clear communication to reduce the number of issues in registration and submissions as well as create a better partnership with participants. 2030 LUCA materials should consider the following:

- Apply clear and concise plain language throughout the documents. Use resources for plain language such as those offered by the Communications Directorate.
- Avoid internal LUCA or Census Bureau jargon or phrases that may confuse external partners. Carefully examine materials for legacy names (such as those for phases or processes) that may no longer apply or make sense and rename them to reflect 2030 LUCA.
- Outline the entire LUCA process in a clear diagram for participants. Link materials or forms to the diagram so participants understand what they will receive from the Census Bureau in each phase and what forms or information participants need to provide.
- Plan for address subject matter experts to be involved in creating the materials, especially any training or content materials.
- Evaluate what information needs to be in the training and content materials and consider alternatives to users guides.
- Consider how participants may have different business needs in their address data than the Census Bureau and provide clear information on how the Census Bureau uses addresses.
- Give participants guided techniques to examine coverage in their address list rather than them only comparing their address list to their LUCA address list. Show common examples of differences participants may find between their data and the LUCA address list along with clear guidelines of what types of differences will affect coverage and what differences will not affect how their addresses are enumerated.

Recommendation 4: Develop interactive computer-based training for LUCA participants

Many other operations successfully use computer-based training to train temporary field staff as well as geography units at NPC. This type of training is more interactive than asking participants to read a user guide that is more than 100 pages. In 2020 LUCA, many participants said that they did not read the user guides and their submissions often contained undesirable formatting or did not follow guidelines for address updates, which required additional time and resources in processing. Computer-based training can be broken up into modules so that participants can complete core modules and then only the additional modules that apply to

them. The 2030 LUCA design should consider whether to make completing a core set of computer-based training mandatory for LUCA participants to submit updates to the Census Bureau.

Along with the computer-based training, 2030 LUCA should include a decision tree to lead LUCA participants through the steps of comparing their address list to the Census Bureau's address list and guide participants to sound address updates. Computer-based training and a LUCA decision tree will ensure uniformity in LUCA training. The Census Bureau can still hold webinars and training sessions for LUCA and consider asking participants to complete the core computer-based training prior to attending so that participants will all have the same basic knowledge and can ask focused questions or review tricky scenarios in their data.

It will be important for 2030 LUCA to develop prototypes of this training early to allow for testing, ideally with participants. 2030 LUCA will also need funding to create the computer-based training.

Recommendation 5: Begin LUCA earlier in the decade

Schedule LUCA earlier in the decade. LUCA has traditionally occurred close to the decennial census to ensure that participants can review and update addresses for the census. However, as the address frame has become more mature and participation in LUCA is greater, the timeline of LUCA has resulted in LUCA processing occurring during a critical time where other geographic updates are competing for resources and LUCA updates cannot undergo a full review before they are applied to the MAF. Of the addresses added by LUCA participants that did not match to the MAF, 62.4 percent were not enumerated and therefore, additional time for reviewing LUCA submissions would likely be helpful. In another example, LUCA Address Validation had to use sampling for review because the number of addresses exceeded expectations and there was not enough time to review them all. Applying LUCA addresses to the MAF without sufficient review can affect the quality of the address frame.

Beginning LUCA earlier in the decade will also allow more time for testing. As described in challenge six, LUCA is a complex operation and a lack of test data or a soft start resulted in a backlog while staff quickly worked to correct the disconnects in systems and processes. Finally, when In-Office Address Canvassing defined the universe that would require In-Field Address Canvassing in 2019, they could not take LUCA updates into account because of the LUCA timeline. Ideally, LUCA should occur before future operations similar to In-Office Address Canvassing determine where listing operations occur in 2030.

Recommendation 6: Research restricting LUCA actions to only adds and deletes

2030 LUCA should research restricting participant actions to adding or deleting addresses only. As described in challenge eight, participants frequently submitted address changes to Census Bureau addresses that took time and resources to process but did not improve the quality of the address frame. With this recommendation, participants should still be able to geocode

ungeocoded addresses or correct geocodes in LUCA. 2030 LUCA should conduct research on whether restricting actions to adds and deletes will help the operation in 2030, the effects, the drawbacks, and test this proposed measure with a variety of participants prior to 2030 LUCA.

Recommendation 7: Explore conducting a LUCA test as well as using a soft start in 2030 LUCA

LUCA is a large operation that occurs during a critical time for the decennial census. Four of the 2020 LUCA challenges (challenges five, six, seven, and eight) may have been reduced or eliminated by conducting a test prior to LUCA. It is often difficult to predict how LUCA participants will interpret LUCA guidelines and despite a solid plan, some Census Bureau guidance is interpreted in unforeseen ways once the target audience (in this case, governments) starts using it. Additionally, other recommendations have the potential to increase operational efficiencies but should be tested before 2030 LUCA. These include the recommendations to restrict LUCA actions to only adds and deletes, conduct research on how to collect ZIP Codes and coordinates, create computer-based training, and improve LUCA materials. Regardless of whether any LUCA test is conducted independently or with a census test, LUCA staff should ensure that there are a variety of participating entities, not just in type but also in the resources they have available and how familiar they are with Census Bureau geography programs. Testing should also include the full LUCA process through feedback the QC components developed by Decennial Statistical Studies Division (DSSD).

Recommendation 8: Conduct research on how to collect ZIP Codes and coordinates in LUCA

In 2020 LUCA, the Census Bureau encountered unforeseen issues in processing addresses without ZIP Codes and with mismatched coordinates that took additional time and resources. However, different issues may have been encountered had the Census Bureau made ZIP Codes mandatory and not collected coordinates in 2020 LUCA. The Census Bureau should conduct research on both processing and dynamics of addresses to determine whether and how it should collect ZIP Codes and coordinates in 2030 LUCA. Ideally, this research would include test submissions from LUCA participants because participants take unforeseen actions with new instructions. Ideally instructions should show participants what the Census Bureau expects as well as what the Census Bureau does not want.

Recommendation 9: Conduct research on the best method to update group quarters (GQs) and transitory locations (TLs) in LUCA in conjunction with the Census Bureau GQ Working Group

Overall, GQs and TLs were not well understood by 2020 Census staff, LUCA participants, and other operation or program participants. In 2020, the Census Bureau did not ask LUCA participants to identify anything about the GQ beyond its name and address, and this caused issues in processing and in sending these GQs on to other 2020 Census processes. Because the Census Bureau did not know the type of GQs coming from LUCA, they did not know which path to enumeration the GQ should follow. However, GQs are complicated and had the Census Bureau asked LUCA participants to include the type of GQ, many participants may have misunderstood the GQ codes and entered an incorrect type anyway and some participants may

have been frustrated by the exercise.

2030 LUCA should conduct research on the best way to update GQs and TLs from LUCA participants. 2030 LUCA should work with the GQ and TL working group to conduct this research.

Recommendation 10: Develop a Plan to Measure Quality in LUCA

The 2030 LUCA Steering Committee should define how the LUCA operation will measure quality by working with DSSD to develop statistically sound quality control plans, implement them in future work, and meet periodically to assess if the work and staff are meeting quality standards and what those standards mean. The following are areas that should be included:

1. Quality of the Design: 2030 LUCA will need to assess the quality of the design of the operation. This quality measure should evaluate both new and legacy elements of the operation and the effect they have on the operation.
2. Quality of Addresses Received and the Effects on the Address Frame: 2030 LUCA should assess the quality of data received from participants as well as both positive and negative effects the updates have on the 2030 address frame. Coordinate with other studies of the address frame to assess the effect of LUCA.
3. Quality of Processing: 2030 LUCA should assess the quality of processing updates and the effect on the 2030 address frame.
4. Quality of Feedback: 2030 LUCA should assess the usefulness of the feedback the Census Bureau provides to participants.

Recommendation 11: Provide tools and resources LUCA participants can use to prepare their own address list before LUCA.

In 2020 LUCA, 17.5 percent of the 8,628 submissions were received late and without having been granted an extension despite participants having 120 days to create their LUCA submission. Some entities do not have good tools or resources available to maintain their address list. The geocoding service available in 2020 LUCA was helpful to participants. For 2030 LUCA, the Census Bureau should provide tools and resources that LUCA participants can use to prepare for LUCA and participate in other partnership programs. This recommendation could tie in with recommendation three in showing participants how to find areas with coverage issues, in this case ahead of LUCA, which could help them target their review in LUCA and results in better data for both participants and the Census Bureau. These tools and resources may include:

- Address count lists.
- Geocoding tools.
- Examples of acceptable and unacceptable address formats.
- Guidelines for submitting addresses so that entities can identify addresses that they use,

such as mile markers or fire hydrants, that the Census Bureau will not need.

- Guidelines and examples of how to use these tools and resources to identify where entities have good coverage and where they may have coverage issues.

Recommendation 12: Research how best to prepare for 2030 LUCA invitations and outreach

The 2030 LUCA Steering Committee guides research on the best method to prepare for 2030 LUCA invitations and outreach and ensure there are resources and funding for this method. In 2020 LUCA, issues in updating the GPP and defining 2020 LUCA contacts resulted in LUCA staff spending additional time and resources to correct the issues, sending LUCA materials to out of date contacts, and some participants receiving duplicate forms (challenge five). In 2030, partnership programs may use additional tools to connect with participants and 2030 LUCA should ensure there is a well-defined plan for 2030 LUCA outreach as well as the support to execute the plan.

Recommendation 13: Investigate a digital LUCA secure online system

2020 LUCA encountered data entry mistakes and issues when keying participant forms into the PCS and GPP, in addition to those processes requiring resources to key data. Additionally, the registration process where multiple forms were needed was confusing to participants and required Census Bureau resources to follow-up with entities with partially incomplete registration. 2020 LUCA also required numerous mailings to participants, not only mailings of forms but also materials. Finally, some participants encountered permission issues with installing GUPS on their computers.

2030 LUCA should consider a digital online system where LUCA participants could register, securely review the addresses for their jurisdiction, and submit their LUCA updates. A secure online system could make LUCA more efficient and reduce common resource intensive portions of the operation, such as reducing data entry and mailout, as well as making LUCA a better experience for participants.

Recommendation 14: Encourage LUCA participants to work with high-level governments and consolidate their submissions

During the planning and outreach phase of the 2030 LUCA, the Census Bureau should encourage its stakeholders to coordinate and where possible “roll up” address submissions through higher-level governments where possible. Many local governments already provide their address data to their respective higher-level governments, such as counties and states, which places the higher-level governments in a position to then provide a consolidated address update to the Census Bureau. This consolidated approach would reduce the likelihood of the Census Bureau receiving duplicate responses from overlapping governments and reduce the overall number of submissions for processing without negatively impacting the operation. Note that this recommendation would not supersede the requirements that individual governments

to have the opportunity to review or submit addresses for their government and would require some coordination and/or delegation of authority to enable the governments to share their submissions with one another.

7. Review / Approval Table

The individuals or groups that appear in the table below have reviewed and approved this operational assessment report.

Role	Approval Date
Decennial Census Management Division (DCMD) ADC for Geographic Operations	3/11/2022
Geography Division (GEO), 2020 Census Coordinator	3/11/2022
Chief, Decennial Census Management Division (DCMD)	4/14/2022
Chief, Geography Division (GEO)	4/28/2022
Decennial Research Objectives and Methods (DROM) Working Group	5/5/2022
Decennial Communications Coordination Office (DCCO)	6/27/2022
Disclosure Review Board	10/17/2022

8. Document Revision and Version Control History

The table below includes entries for each major version of this operational assessment report along with a brief description of the version and/or any changes made to the preceding version.

Version/Editor	Date	Version Description/Revisions
0.1/Hanks	12/22/2021	Initial Draft
0.2/Hanks	1/13/2022	Revised Initial Draft
0.3/Hanks	2/17/2022	Initial Draft, Second IPT Review
0.4/Hanks	3/4/2022	Initial Draft, Final IPT Review
0.5/Hanks	3/18/2022	Initial Draft, Division Chief Review
0.6/Hanks	4/14/2022	Initial Draft, DROM Review
0.7/Hanks	6/9/2022	Final Draft
1.0/Hanks	6/27/2022	Final Version
1.1/Hanks	10/17/2022	External Release Version

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Decennial Budget Office: Richard Griggs, Anne Lutu

Decennial Census Management Division: Melody Troxell, Carrie Butikofer

Appendix A: Glossary of Acronyms

Acronym	Definition
ACS	American Community Survey
AIA	American Indian Area
ASE	Address Source Evaluation
BCU	Basic Collection Unit
CC	Courtesy Copy
CO	County
COG	Council of Governments
DBO	Decennial Budget Office
DCCO	Decennial Communications Coordination Office
DCMD	Decennial Census Management Division
DITD	Decennial Information Technology Division
DROM	Decennial Research Objectives and Methods Working Group
DSF	Delivery Sequence File
DSSD	Decennial Statistical Studies Division
FLD	Field Division
FSCPE	Federal-State Cooperative Program for Population Estimates
FY	Fiscal Year
GATRES	Geographic Acquis-based Topological Real-time Editing System
GEO	Geography Division
GEOID	Geographic Identifier
GIS	Geographic Information System
GPP	Geographic Program Participant System
GPSD	Geographic Programs Support Desk
GQ	Group Quarters
GQPCS	GQ Production Control System
GQV	Group Quarters Validation
GSS	Geographic Support System Initiative
GUPS	Geographic Update Partnership Software
HEO	Highest Elected Official
HU	Housing Unit
IFAC	In-Field Address Canvassing
IMS	Integrated Master Schedule

Acronym	Definition
IOAC	In-Office Address Canvassing
IPT	Integrated Project Team
LAV	LUCA Address Validation
LMT	LUCA Master Table
LUCA	Local Update of Census Addresses
MaCS	Matching and Coding Software
MAF	Master Address File
MAFID	Master Address File Identification Number
MCD	Minor Civil Division
MSP	MAF Structure Point
MTAG	MAF/TIGER Address Geocoding Application
MTDB	MAF/TIGER Database
MTPS	MAF/TIGER Partnership Software
NAS	National Academy of Sciences
NPC	National Processing Center
NRFU	Nonresponse Followup operation
OIG	Office of the Inspector General
OMB	Office of Management and Budget
QC	Quality Control
PCS	Production Control System
PL	Place
RCC	Regional Census Center
RO	Regional Office
SDC	State Data Center
SME	Subject-Matter Expert
ST	State
TEA	Type of Enumeration Area
TIGER	Topologically Integrated Geographic Encoding and Referencing System
TL	Transitory Location
USPS	United States Postal Service
ZIP	Zone Improvement Plan

Appendix B: Additional Analysis Tables

Additional tables related to Question 3

Table 75. Original Material Choice for Registered LUCA Entities

Material Choice	Total	Percent	AIA	ST	CO	MCD	PL
Total	**11,549**		**146**	**47**	**1,866**	**2,198**	**7,292**
			1.3%	0.4%	16.2%	19.0%	63.1%
Paper/Paper	1,592	13.8%	8	0	23	487	1,074
			0.5%	0.0%	1.4%	30.6%	67.5%
Paper/Paper PDF	1,699	14.7%	19	0	33	435	1,212
			1.1%	0.0%	1.9%	25.6%	71.3%
Paper/Digital	10	0.1%	0	0	0	1	9
				0.0%	0.0%	10.0%	90.0%
Digital/Paper	84	0.7%	0	0	9	21	54
				0.0%	10.7%	25.0%	64.3%
Digital/Paper PDF	1,490	12.9%	23	0	106	332	1,029
			1.5%	0.0%	7.1%	22.3%	69.1%
Digital/Digital	6,674	57.8%	96	47	1,695	922	3,914
			1.4%	0.7%	25.4%	13.8%	58.6%

Source: 2020 LUCA Production Control System

Table 76. Original Material Choice for Registered LUCA Entities by Entity Type

	Total	Percent	Paper/ Paper	Paper/ Paper PDF	Paper/ Digital	Digital/ Paper	Digital/ Paper PDF	Digital/ Digital
Total	**11,549**		**1,592**	**1,699**	**10**	**84**	**1,490**	**6,674**
			13.8%	14.7%	0.1%	0.7%	12.9%	57.8%
AIA	146	1.3%	8	19	0	0	23	96
			5.5%	13.0%	0.0%	0.0%	15.8%	65.8%
ST	47	0.4%	0	0	0	0	0	47
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
CO	1,866	16.2%	23	33	0	9	106	1,695
			1.2%	1.8%	0.0%	0.5%	5.7%	90.8%
MCD	2,198	19.0%	487	435	1	21	332	922
			22.2%	19.8%	0.0%	1.0%	15.1%	41.9%
PL	7,292	63.1%	1,074	1,212	9	54	1,029	3,914
			14.7%	16.6%	0.1%	0.7%	14.1%	53.7%

Source: 2020 LUCA Production Control System

Table 77. Original Material Choice Preference by Entity Size

	Total	Percent	Paper/ Paper	Paper/ Paper PDF	Paper/ Digital	Digital/ Paper	Digital/ Paper PDF	Digital/ Digital
Total	**11,549**		**1,592**	**1,699**	**10**	**84**	**1,490**	**6,674**
			13.8%	14.7%	0.1%	0.7%	12.9%	57.8%
1,000 or Fewer Addresses	4,278	37.0%	1,201	1,239	6	18	562	1,252
			28.1%	29.0%	0.1%	0.4%	13.1%	29.3%
1,001 – 6,000 Addresses	3,615	31.3%	381	453	4	49	673	2,055
			10.5%	12.5%	0.1%	1.4%	18.6%	56.8%
6,001 – 50,000 Addresses	2,994	25.9%	10	7	0	17	252	2,708
			0.3%	0.2%	0.0%	0.6%	8.4%	90.4%
50,001 – 100,000 Addresses	316	2.7%	0	0	0	0	1	315
			0.0%	0.0%	0.0%	0.0%	0.3%	99.7%
100,001 – 1,000,000 Addresses	305	2.6%	0	0	0	0	2	303
			0.0%	0.0%	0.0%	0.0%	0.7%	99.3%
1,000,001 or More Addresses	41	0.4%	0	0	0	0	0	41
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Source: 2020 LUCA Production Control System

Table 78. Final Material Choice for Registered LUCA Entities

Material Choice	Total	Percent	AIA	ST	CO	MCD	PL
Total	**11,549**		**146**	**47**	**1,866**	**2,198**	**7,292**
			1.3%	0.4%	16.2%	19.0%	63.1%
Paper/Paper	1,632	14.1%	8	0	25	495	1,104
			0.5%	0.0%	1.5%	30.3%	67.6%
Paper/Paper PDF	1,735	15.0%	19	0	33	451	1,232
			1.1%	0.0%	1.9%	26.0%	71.0%
Paper/Digital	10	0.1%	1	0	0	1	8
			10.0%	0.0%	0.0%	10.0%	80.0%
Digital/Paper	86	0.7%	0	0	6	20	60
			0.0%	0.0%	7.0%	23.3%	69.8%
Digital/Paper PDF	1,484	12.8%	23	0	100	333	1,028
			1.5%	0.0%	6.7%	22.4%	69.3%
Digital/Digital	6,602	57.2%	95	47	1,702	898	3,860
			1.4%	0.7%	25.8%	13.6%	58.5%

Source: 2020 LUCA Production Control System

Table 79. Final Material Choice for Registered LUCA Entities by Entity Type

	Total	Percent	Paper/ Paper	Paper/ Paper PDF	Paper/ Digital	Digital/ Paper	Digital/ Paper PDF	Digital/ Digital
Total	**11,549**		**1,632**	**1,735**	**10**	**86**	**1,484**	**6,602**
			14.1%	15.0%	0.1%	0.7%	12.9%	57.2%
AIA	146	1.3%	8	19	1	0	23	95
			5.5%	13.0%	0.7%	0.0%	15.8%	65.0%
ST	47	0.4%	0	0	0	0	0	47
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
CO	1,866	16.2%	25	33	0	6	100	1,702
			1.3%	1.8%	0.0%	0.3%	5.4%	91.2%
MCD	2,198	19.0%	495	451	1	20	333	898
			22.5%	20.5%	0.0%	0.9%	15.2%	40.9%
PL	7,292	63.1%	1,104	1,232	8	60	1,028	3,860
			15.1%	17.0%	0.1%	0.8%	14.1%	52.9%

Source: 2020 LUCA Production Control System

Table 80. Final Material Choice Preference by Entity Size

	Total	Percent	Paper/ Paper	Paper/ Paper PDF	Paper/ Digital	Digital/ Paper	Digital/ Paper PDF	Digital/ Digital
Total	**11,549**		**1,632**	**1,735**	**10**	**86**	**1,484**	**6,602**
			14.1%	15.0%	0.1%	0.7%	12.8%	57.2%
1,000 or Fewer Addresses	4,277	37.0%	1,228	1,255	6	21	563	1,204
			28.7%	29.3%	0.1%	0.5%	13.2%	28.2%
1,001 – 6,000 Addresses	3,616	31.3%	392	473	4	47	678	2,022
			10.8%	13.1%	0.1%	1.3%	18.8%	55.9%
6,001 – 50,000 Addresses	2,994	25.9%	12	7	0	18	240	2,717
			0.4%	0.2%	0.0%	0.6%	8.0%	90.7%
50,001 – 100,000 Addresses	316	2.7%	0	0	0	0	1	315
			0.0%	0.0%	0.0%	0.0%	0.3%	99.7%
100,001 – 1,000,000 Addresses	305	2.6%	0	0	0	0	2	303
			0.0%	0.0%	0.0%	0.0%	0.7%	99.3%
1,000,001 or More Addresses	41	0.4%	0	0	0	0	0	41
			0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Source: 2020 LUCA Production Control System

Additional tables related to Question 22

Table 81. LUCA Addresses Assigned a Feedback Code for Housing Units (HUs)

	Total	Percent	AIA	ST	CO	MCD	PL
All Feedback Codes	**23,660,000**						
			0.2%	17.2%	47.8%	1.9%	32.9%
HUs	23,550,000	**99.5%**					
			0.2%	17.1%	47.9%	1.9%	32.9%
A01	16,380,000	69.5%					
			0.1%	15.9%	45.2%	1.9%	36.9%
A02	749,000	3.2%					
			<0.1%	32.8%	53.1%	0.9%	13.2%
A03	1,100,000	4.7%					
			0.7%	5.3%	60.7%	3.5%	29.8%
R01	3,082,000	13.1%					
			0.1%	3.0%	70.2%	1.5%	25.2%
R02	152,000	0.6%					
			0.1%	1.9%	53.7%	1.9%	42.4%
R03	594,000	2.5%					
			0.2%	11.5%	35.6%	1.4%	51.3%
X01	1,499,000	6.4%					
			0.2%	63.8%	25.1%	1.6%	9.3%

Source: LUCA Master Table.
Numbers may not sum because of rounding.

Table 82. LUCA Addresses Assigned a Feedback Code for Group Quarters (GQs)

	Total	Percent	AIA	ST	CO	MCD	PL
All Feedback Codes	**23,660,000**						
			0.2%	17.2%	47.8%	1.9%	32.9%
GQs	104,000	**0.4%**					
			0.0%	49.7%	22.1%	1.7%	26.4%
A01	40,000	38.4%					
			0.1%	18.4%	33.2%	2.7%	45.6%
A02	1,700	1.7%					
			<0.1%	46.4%	29.6%	1.2%	22.8%
A03	10,500	10.3%					
			0.2%	36.4%	27.8%	3.8%	31.8%
R01	21,500	20.7%					
			<0.1%	68.7%	13.7%	0.7%	16.9%
R02	300	0.3%					
			0.0%	58.1%	28.4%	1.3%	12.1%
R03	20,500	19.6%					
			<0.1%	91.6%	3.8%	0.2%	4.4%
X01	9,500	9.1%					
			<0.1%	63.8%	25.9%	0.6%	9.7%

Source: LUCA Master Table.
Numbers may not sum because of rounding.

Table 83. LUCA Addresses Assigned a Feedback Code for Transitory Locations (TLs)

	Total	Percent	AIA	ST	CO	MCD	PL
All Feedback Codes	**23,660,000**						
			0.2%	17.2%	47.8%	1.9%	32.9%
TLs	3,300	**<0.1%**					
			0.0%	18.1%	6.7%	0.2%	75.0%
A01	2,700	80.1%					
			0.0%	4.7%	8.0%	0.2%	87.1%
A02	30	0.8%					
			0.0%	61.5%	3.8%	0.0%	34.6%
A03	<15	0.1%					
			0.0%	0.0%	50.0%	0.0%	50.0%
R01	200	6.6%					
			0.0%	95.4%	0.5%	0.0%	4.1%
R02	0	0.0%					
			0.0%	0.0%	0.0%	0.0%	0.0%
R03	400	12.4%					
			0.0%	61.2%	1.5%	0.0%	37.3%
X01	0	0.0%					
			0.0%	0.0%	0.0%	0.0%	0.0%

Source: LUCA Master Table
Numbers may not sum because of rounding.

Additional tables related to Question 27

Table 84. Budget, Actual Costs, and Variance for the LUCA Operation by Fiscal Year and Division

Fiscal Year/Division	Planned Costs	Actual Costs	Variance
2016	**$2,047,821**	**$1,682,092**	**$365,729**
ADDC	$0	$100	($100)
DCMD	$230,196	$199,172	$31,024
DITD	$171,811	$50,040	$121,771
FLD	$361,897	$296,601	$65,296
GEO	$1,204,591	$1,077,825	$126,766
NPC	$79,326	$58,354	$20,972
2017	**$9,092,313**	**$7,669,822**	**$1,422,491**
ADRM	$0	$7,751	($7,751)
CBSM	$0	$0	$0
CLMSO	$0	$426	($426)
DCMD	$274,296	$283,624	($9,328)
DITD	$1,618,944	$1,448,139	$170,805
DSSD	$36,692	$23,445	$13,247
ERD	$0	$0	$0
FLD	$3,129,119	$2,403,377	$725,742
GEO	$1,577,027	$1,832,825	($255,798)
NPC	$2,456,235	$1,666,906	$789,329
OCIA	$0	$2,584	($2,584)
PIO	$0	$746	($746)

Fiscal Year/Division	Planned Costs	Actual Costs	Variance
2018	**$10,624,968**	**$8,755,565**	**$1,869,403**
ADDP	$0	$252	($252)
ADRM	$0	$2,700	($2,700)
DCMD	$191,060	$220,680	($29,620)
DIR	$0	$0	$0
DITD	$445,276	$487,246	($41,970)
DSSD	$108,820	$53,759	$55,061
FLD	$2,371,544	$1,414,204	$957,340
GEO	$2,568,235	$3,329,573	($761,338)
NPC	$4,940,033	$3,242,934	$1,697,099
OCIA	$0	$4,219	($4,219)
2019	**$4,892,039**	**$4,406,762**	**$485,277**
ADDP	$0	$58	($58)
DCMD	$185,023	$122,828	$62,195
DITD	$194,224	$245,682	($51,458)
DSSD	$96,521	$37,998	$58,523
FLD	$783,963	$847,390	($63,427)
GEO	$2,102,943	$2,032,092	$70,851
NPC	$1,529,365	$1,120,715	$408,650
2020	**$1,337,753**	**$890,797**	**$446,956**
DCMD	$231,413	$136,780	$94,633
DITD	$106,063	$7,526	$98,537
DO	$0	($789)	$789
DSSD	$11,083	$1,499	$9,584
FLD	$668,492	$464,778	$203,714
GEO	$320,702	$273,469	$47,234
NPC	$0	$7,534	($7,534)
2021	**$665,638**	**$365,441**	**$300,197**
DCMD	$123,039	$101,041	$21,998
DSSD	$60,628	$0	$60,628
FLD	$130,127	$169,390	($39,263)
GEO	$351,844	$88,373	$263,471
NPC	$0	$6,638	($6,638)
Grand Total	**$28,660,532**	**$23,770,478**	**$4,890,054**

Source: Decennial Budget Office